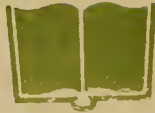


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AIR TRANSPORTATION AND SAN FRANCISCO BAY

**BY
CLIFFORD W. GRAVES
ASSOCIATE PLANNER
SEPTEMBER 1966**

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PREPARED FOR

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

A I R T R A N S P O R T A T I O N
A N D
S A N F R A N C I S C O B A Y

by

Clifford W. Graves
Associate Planner

This volume is one of a series of background reports being prepared for the San Francisco Bay Conservation and Development Commission by the Commission's staff, by various State agencies, and by private consultants. Summaries of these reports are also being prepared for wide distribution. The summary reports will provide the Commission with the basis for determining policies and criteria upon which to base its plan for the future of the Bay.

Prepared for the
San Francisco Bay Conservation and Development Commission
September, 1966

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INTRODUCTION

The purpose of this report is to discuss the problem of air transportation as it relates to the task of the San Francisco Bay Conservation and Development Commission. The report includes background material for the airport section of the Commission's plan and also for interim policy regarding airport development around the Bay.

Realistic policies regarding airports from the standpoint of Bay fill can only come from an understanding of the importance of air travel to the Bay Area, and the complex problems that airport operators face in attempting to cope with rapid growth and change. Therefore this report includes discussion of topics that at first may appear to be outside the Commission's sphere of interest. While not intended to be an exhaustive treatment of the subject, this report is intended to illustrate the scope of the problem sufficiently to provide a basis for Commission policy. For example, considerable space is given to the governmental context in which decisions relating to Bay Area airports are made. This context is a major limitation on airport planning here, and it could have serious consequences for the future of both the Bay and air transportation in the Bay Area.

There are four sections to the report. Part I describes the general nature and growth of air transportation, technological progress in the aircraft industry, and the kinds of air travel facilities that will be necessary in the future. Part II describes the characteristics of air transportation in the Bay Area: volume of traffic, local airport facilities, public agencies responsible for air transportation, and the relation of air transportation to other aspects of regional development. The effects of air transportation on San Francisco Bay and its shoreline are discussed in Part III. Part IV lists the conclusions of the study and discusses suggested criteria for Commission policy.

PART I. AIR TRANSPORTATION, PRESENT AND FUTURE

Air transportation is many things to many people, and there are few persons today whose lives are not somehow affected by it. For the businessman it is an essential means of access to distant markets. For the family with limited vacation time it makes travel to far-away places feasible. For many persons it is a substitute recreation for sailing or golf. The New England housewife can thank it for fresh California strawberries and flowers. It is at the heart of our national defense. It is worth thousands of jobs and millions of dollars to a metropolitan area. For the person living near an airport it may be a noisy nuisance. Whatever one thinks of it, air travel is not only "the wave of the future;" it is with us now.

The Growth of Air Transportation

With the exception of military flights, all phases of aviation activity are expanding rapidly. More people and goods are being moved by air and more aircraft of all types are flying now than ever before. There is no indication that this growth will slow down; it is more likely to accelerate.

1. Airline Passenger Traffic

We are accustomed to hearing about the rapid rate of population growth in America and particularly in California; but the rate of increase in airline passenger traffic is even more rapid than population growth, as Figures 1 and 2 show. While the U. S. population increased by 19% between 1953 and 1963, airline passenger enplanements* increased by 149%. Growth was even more rapid in California: while the state's population increased by 45% from 1953 to 1963, airline passenger enplanements in California rose by 217%.

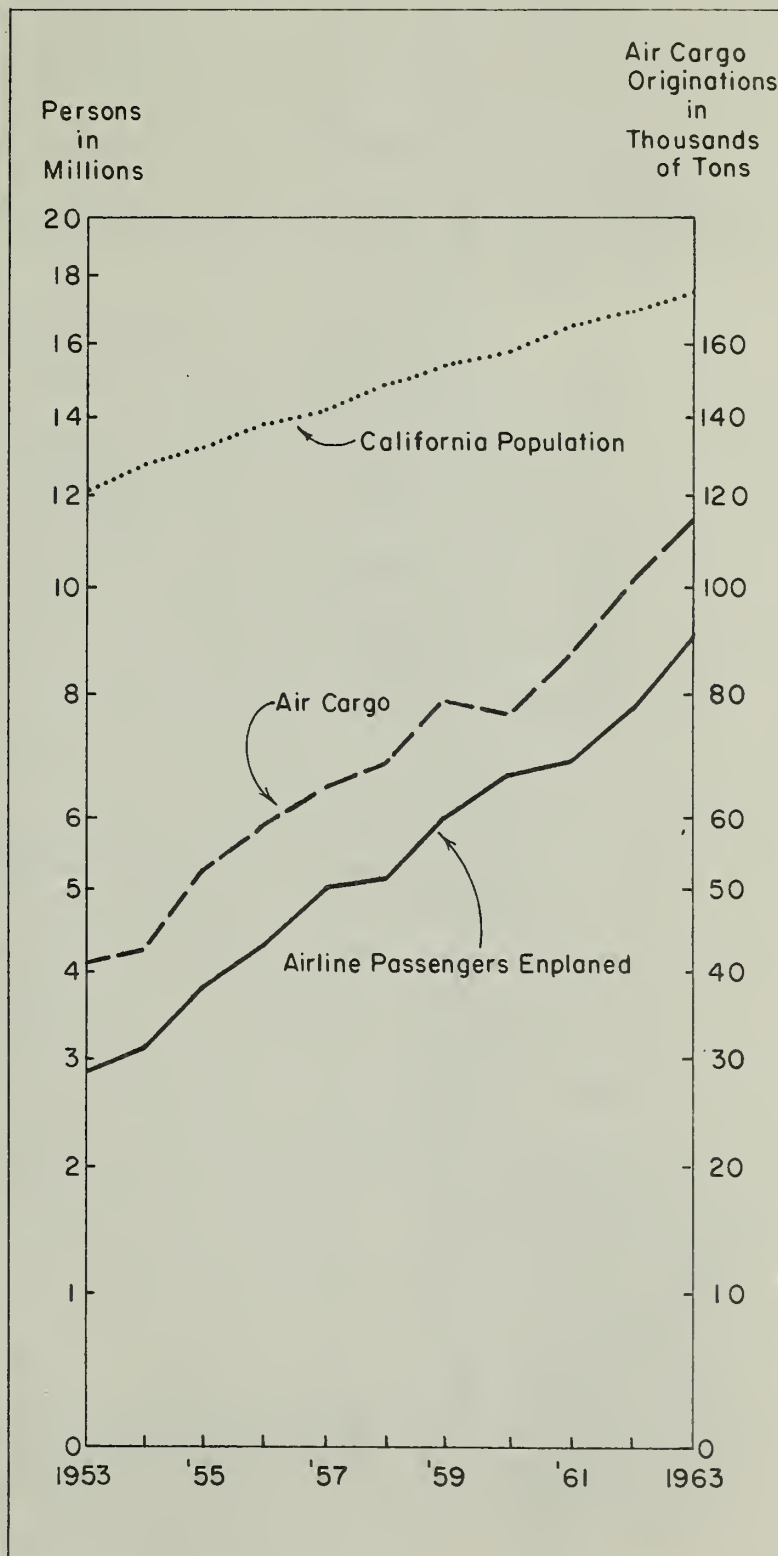
The growth of domestic air travel has accelerated sharply in the last few years. In fiscal years 1964 and 1965, U. S. domestic passenger-miles increased 18% and 15%, respectively, compared to 7% in fiscal 1963. Growth in international air travel was even more rapid: scheduled passenger-miles flown by the U. S. international air carriers rose 19% in fiscal year 1965.^{1/} One of the main factors behind this growth is the steady decline in airline passenger fares. Air travel is now within the budget limitations of more people than ever before.

* Passenger enplanements are the total number of revenue passengers boarding aircraft of scheduled air carriers (in scheduled and non-scheduled operations), including originating, stopover and transfer passengers.

^{1/} U. S. Aviation Agency, Office of Policy Development, Economics Division, Aviation Forecasts, Fiscal Years 1966-1971, Washington, D. C., December 1965, p. 2

FIGURE 1

Comparison of
California
Airline Passenger,
Air Cargo,
and Population
Growth Rates
1953-1963

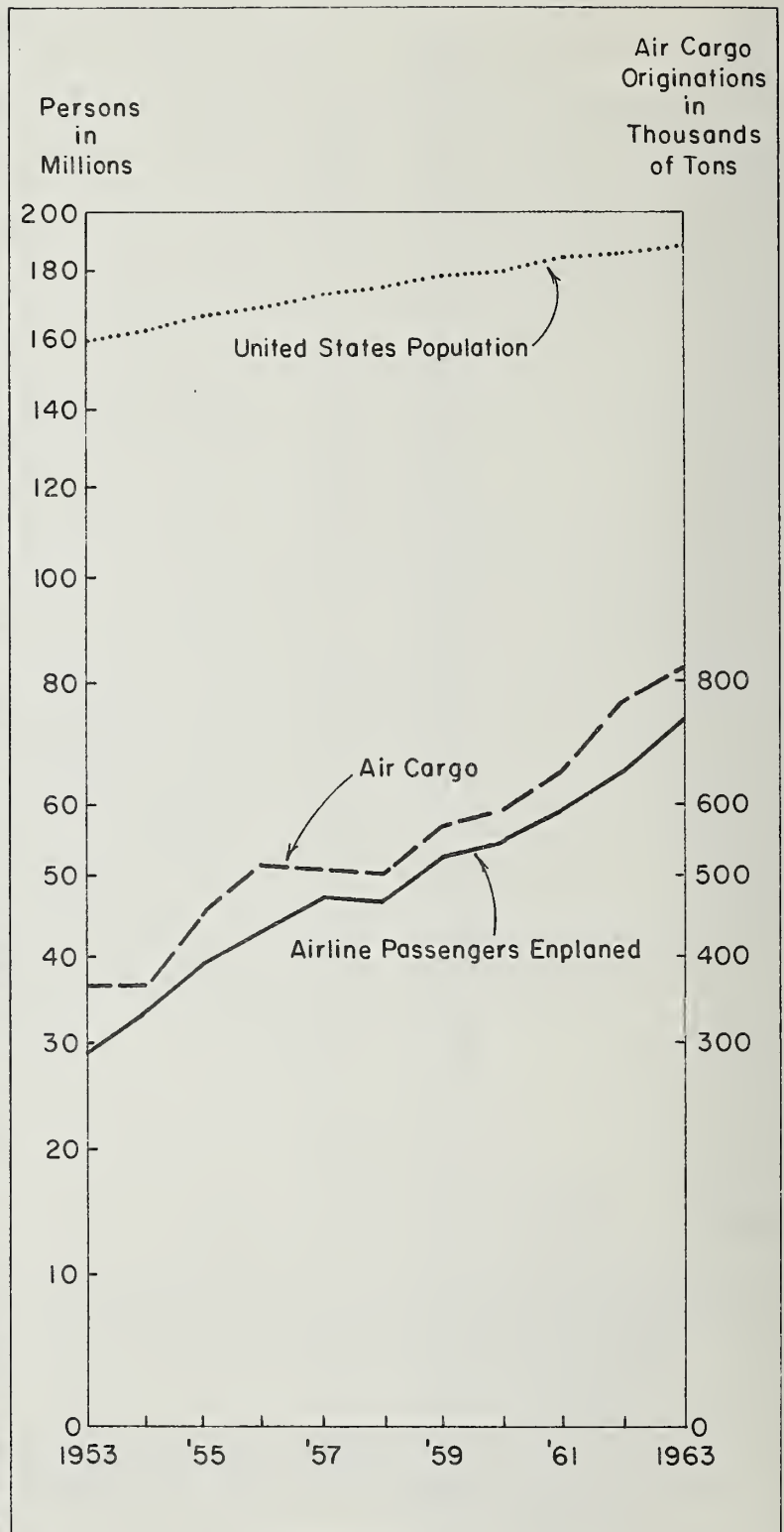


Source:
Stanford Research
Institute
Air Terminal
Requirements in
California
through 1975
Report prepared
for California
State Office of
Planning
January 1966

FIGURE 2

Comparison of
U.S.
Airline Passenger,
Air Cargo,
and Population
Growth Rates
1953-1963

Source:
Stanford Research
Institute
Air Terminal
Requirements in
California
through 1975
Report prepared
for California
State Office of
Planning
January 1966



According to the Federal Aviation Agency, the high rate of growth will continue. By fiscal year 1971 the United States airlines are expected to fly a total of 113 billion revenue passenger-miles and nearly 160 million passengers in scheduled domestic and international service, compared to 63 billion revenue passenger-miles and 95 million passengers in fiscal year 1965. (See Table 1.)

2. Air Cargo

The air cargo industry is still in its infancy, so that its rate of growth is difficult to predict. Air cargo tonnage is currently increasing nationally at the rate of about 20% per year. The steady decline in air cargo rates and the rapid expansion of commercial jet fleets has resulted in a nearly three-fold increase in air cargo tonnage originating in California between 1953 and 1963. (See Figure 1.)

In California the principal air freight commodities are:^{2/}

Outbound

Flowers

Fruits and Vegetables

Aircraft Parts

Electronic Equipment

Import Traffic

Inbound

Auto Parts

Machine Parts

Wearing Apparel

Military Traffic

Printed Matter

^{2/} Guy M. Springer, Jr., "California's Air Cargo Lift, Testimony before the Transportation Committees of the California Legislature," June 17, 1964

TABLE 1

UNITED STATES SCHEDULED AIRLINE PASSENGER TRAFFIC
FISCAL YEARS 1961-1971

<u>Fiscal Year</u>	<u>Total Revenue Passengers (Millions)**</u>	<u>Total Revenue Passenger- miles (Billions)**</u>
1961	61.8	38.8
1962	66.6	42.5
1963	70.7	45.9
1964	83.0	54.2
1965	94.6	62.6
1966*	107.5	72.0
1967*	117.5	79.7
1968*	126.8	81.1
1969*	136.6	95.0
1970*	147.3	103.5
1971*	158.6	112.6

* Forecast

** Includes domestic and international traffic on U. S. flag carriers only

Source: U. S. Federal Aviation Agency, Aviation Forecasts, Fiscal Years 1961-1971, Washington, D.C., December 1965

As one example of the importance of air cargo to a California industry, air cargo shipments of California flowers in 1963 were valued at \$35 million.

Although the number of all-cargo flights will increase in the future, a substantial proportion of air cargo tonnage will continue to be carried on passenger flights.

3. General Aviation

The Federal Aviation Agency defines general aviation as representing "all domestic civil flying except that performed by the public carriers." Included in this class are recreational or pleasure flying, flight instruction, business or executive flying, air charter and taxi operations, and governmental and industrial flying. In terms of number of aircraft and total hours flown, general aviation is by far the largest segment of air transportation activity in the United States, and is expected to become even larger in the future. As an illustration, there are more than 97,000 general aviation aircraft in the United States, compared to about 2,100 aircraft in the U. S. air carrier, or commercial, fleet. By 1971 there will be about 123,400 general aviation aircraft in this country, compared to 2,400 aircraft in the air carrier fleet.^{3/} While the air carrier fleet logged 4.33 million revenue aircraft hours during fiscal 1965, general aviation logged 16.2 million hours.^{4/} California has more general aviation aircraft

^{3/} U. S. Federal Aviation Agency, op. cit., pp. 19 and 22

^{4/} Ibid., pp. 20 and 23

than any other state and the trend is toward greater concentration of general aviation in metropolitan areas. The volume of general aviation aircraft operations in California during 1965 was a two-fold increase over 1960.^{5/}

Much of the increase in general aviation activity is due to its growing importance as a mode of business transportation. Nearly 40% of the total general aviation hours flown in 1965 were for business purposes. Air taxi and executive aircraft are now commonly used for short-distance business trips and to connect outlying areas with major commercial airports. Metropolitan areas are more and more coming to be the "hubs" for this kind of activity. The importance of general aviation to business is evidenced by the increasing number of airports being proposed and developed in industrial parks and close to centers of economic activity.

Trends in Air Transportation - New Forms of Aircraft

An important factor behind the increasing popularity of air transportation is the technological progress that has made air travel faster, cheaper, more comfortable and more reliable for more purposes. The pace of technological development in the aircraft industry is still very rapid and several projects now under way have important implications for transportation planning.

^{5/} Walter E. Gillfillan, California Airports: Facilities Inventory, Air Traffic and Land Use Protection, Special Report, Institute of Transportation and Traffic Engineering, University of California, Berkeley, February 1965, p. 24

1. Short-Haul Jets

The most immediate new development in air transportation is the short-haul commercial jets, such as the Boeing 737, Douglas DC-9, and BAC-111, which will be in extensive service by 1970. These aircraft will be smoother and faster, and will have larger capacities than the propeller-aircraft now flying most short-distance routes. At least one of these new jets is being developed as a "QC" (quick-change) model which can be converted from passenger to all-cargo use at different times of the day or week. The effect of these aircraft will be to increase the attractiveness of short-distance air travel and to improve commercial air transport service from smaller airports. The Civil Aeronautics Board has adopted a policy holding new jet fares to a maximum of existing propeller fares, so that new jet service will not, in most cases, result in fare increases.

Also in this class are the increasing number of general aviation jet and turboprop aircraft. Most general aviation airports are not now equipped to handle these high-performance aircraft. Some such airports will be improved to accommodate them, but most of these aircraft will use the major airports.

2. Stretched Subsonic Jets

Airliners having two and three times the cargo and seating capacity of those now in use will be in regular service soon. The "stretched" 250-seat Douglas DC-8 Superjet will be in service

between San Francisco and Honolulu this fall. Jets seating 400 to 500 passengers are expected to be in service within five years. Even larger aircraft are now in the design stage: if the Lockheed C-5A now being developed for military use becomes a commercial reality, 900-seat airliners could be calling at major airports before 1980.

The term "stretched" is applied to these aircraft because they will generally resemble aircraft now in use, but will be larger in nearly every dimension. They will be heavier than present airliners, requiring stronger runways. They will require larger areas for loading and unloading passengers, and handling facilities inside air terminals may have to be modified to accommodate the larger passenger and cargo loads. These planes will be able to use the runways now required by longer international flights.

One of these new aircraft, the Boeing 747, is described in Table 2. Three versions are planned, an all-passenger model seating 490 (compared to 187 in the popular 707), a mixed passenger-cargo model, and an all-cargo version. This airplane will be able to carry more cargo or passengers than any two commercial airliners presently in use, with a slight improvement in performance over the 707. The first of the 747's will be introduced into service in late 1970.

It is expected that these aircraft will have lower passenger-seat-mile and cargo ton-mile costs than aircraft now in use, so that fares and rates will probably be reduced. This should

TABLE 2

THE "STRETCHED" JETBOEING 747 COMPARED WITH BOEING 707-321

	Boeing 747	Boeing 707-321
Normal Cruising Speed	Mach .90	Mach .82
Passenger Capacity (all thrift)	490	187
Cargo Payload (pounds)	214,000	76,400
Engine Thrust (sea-level static condition in pounds)	41,000	18,000
Overall Length	228' 6"	152' 11"
Wingspan	195' 7"	145' 9"
Maximum Gross Weight (at takeoff in pounds)	680,000	333,100
Operating Altitudes (feet)	Up to 45,100	Up to 42,000
Maximum Operating Range (statute miles)	Up to 6,000	Up to 6,000
Runway Takeoff Requirements (86°F - full gross at sea-level)	9,150'	11,100'
Approximate Direct Cost Per Passenger-Mile, Thrift Configuration (cents)	.63	.92
Approximate Direct Cost Per Cargo Ton-Mile (cents)	3.0	4.6

Source: Pan American World Airways, The Pan American Clipper, Vol. 25, No. 9, April 18, 1966, p. 1

increase the attractiveness of air transport relative to other modes of travel with resultant increase in demand.

3. Supersonic Transports (SST)

The most glamorous and controversial of the current development projects is the supersonic airliner, one version of which is expected to be in service before 1975. Besides drastically reducing flying time on transcontinental and international routes, these airliners will have a higher seating capacity than those now in use; the United States version will probably seat about 250 passengers. Despite the fact that the SST is still in the design stage, the U. S. air carriers at present have reserved delivery positions for 65 supersonic transport aircraft -- 44 of the U. S. model and 21 British-French Concorde^{6/}.

International Civil Aviation Organization and Federal Aviation Agency policy states that all versions of United States and foreign supersonic airliners must have acceptable airport behavior characteristics and require no basic change in runways or other airport facilities. The aircraft is still in the design stage; so that the seriousness of noise, blast and other problems are not yet known. The aircraft will fly at subsonic speeds during approach and takeoff maneuvers. They are not expected to require any major changes in airport design and space standards beyond those required by the stretched jets that will already be in service by that time.

^{6/} U. S. Federal Aviation Agency, op. cit., p. 5

4. Advanced Helicopters

One of the factors retarding the expansion of metropolitan helicopter service is the relatively high passenger-seat-mile cost, but a major advance is expected to come with the introduction of larger, faster vehicles. One of these, the Sikorsky S-65, should be in commercial service by the late 1960's. This helicopter will have a 65-passenger capacity, about double that of most existing commercial helicopters. It will also have a longer range and higher forward speed. If adequate heliport facilities are developed in and around metropolitan areas, the use of helicopters should increase, not only for access to airports but also as a general transit vehicle within metropolitan areas. The S-65 and other new helicopters will permit the extension of Bay Area service to more distant communities such as Sacramento, Stockton, and Monterey.

A more flexible kind of helicopter will be tested in the Los Angeles area soon. It consists of a 40-passenger Skylounge or "pod" that can be hauled by a tractor-trailer and also by a "flying crane" helicopter, such as is now being used in Viet Nam. If it proves feasible, this type of air-to-surface vehicle might be used as an express bus as well as a special airport access transport.

5. V/STOL Aircraft

Although not expected to be in commercial service until the late 1970's, V/STOL (Vertical and Short Takeoff and Landing) aircraft have implications for air transportation and planning that

warrant early study and preparation. Although helicopters are a type of V/STOL aircraft, the term is usually applied to aircraft that combine the forward speed and handling characteristics of a conventional fixed-wing aircraft with the ability to take off and land in a very small area.

A STOL aircraft is one that can use runways of 1,000 feet or less. A few versions of STOL aircraft, such as the de Havilland DHC-6 and Dornier Do 28, are in use at present. These are relatively small planes designed for use in areas of difficult terrain. The operational V/STOL aircraft is some years away. The Bell X22 VTOL research aircraft flew for the first time in March of this year. The British P1127 jet fighter prototype and American XC-142A propeller aircraft are slightly further advanced.

Both jet- and piston-engine designs are being studied and there is no reason besides cost why these characteristics could not be applied to long-distance as well as short-range aircraft. However, operating costs are expected to be such that V/STOL aircraft will be most economical at stage lengths of 100 to 500 miles. At shorter distances helicopters have the advantage, while at longer stages conventional aircraft will be much more economical.

These aircraft are faster and have a greater carrying capacity than helicopters. V/STOL flights have less "non-productive time" than conventional aircraft; i.e., they require less time for take-off and landing maneuvers. However, the extent of these advantages

will depend to a great extent on the terminal facilities provided for the aircraft in local communities. To be competitive with conventional aircraft, V/STOL aircraft will require terminals close to city centers so that the distance between airports and ultimate passenger destinations is minimized. If appropriate facilities are developed for them, V/STOL aircraft could be providing city-center to city-center service by 1980. Beyond 1980, busy short-distance routes such as Bay Area to Los Angeles could be served exclusively by V/STOL aircraft. However, if V-ports are not provided, then the aircraft will be of limited value in urban areas.

6. Longer-Range Developments

Aircraft development will certainly continue after current projects have become realities. As the year 2000 approaches, the V/STOL and supersonic aircraft will be as commonplace as the DC-8 today; the idea of 600 mph, 200-passenger jet airliners would have been considered fantastic 35 years ago. As an example of what the future may hold, the concept of a "hypersonic" 7000 mph, 10,000 mile-range transport for international service is being discussed.

Much of the results of current space research is applicable to commercial air transportation problems. While it is perhaps premature to begin planning municipal passenger-rocket-launching pads, it would be shortsighted to claim that such facilities will never be needed.

The personal helicopter and airplane will become more popular in the future, but cost and other factors will limit their use to a small minority of the population. Helicopters and V/STOL aircraft will certainly become more common as public transit vehicles.

7. Implications for Planning

By 1980 there will be a specialized type of aircraft for nearly every travel need from local transport within metropolitan areas to flights around the world. Each type of aircraft will have its own facility requirements for optimum utilization. The way that these facilities are provided in a metropolitan area will largely determine how well that area will be served by air transportation. The major air commerce airports* will need improved passenger- and cargo-handling facilities and also enlarged gate positions and stronger runways to accommodate larger and faster jets. Smaller air commerce airports may need improvements in runway and terminal facilities for the increasing number of short-haul and executive jets. Many new heliports will be needed in and around urban areas; an entirely new kind of facility, the V-port, will probably be needed within 15 years. The development of new kinds of aircraft will continue indefinitely; there is no "plateau" in sight.

* Airports whose main function is the handling of airline passengers and cargo.

Other Technological Innovations

While new forms and uses of aircraft are being developed and air traffic is increasing at a rapid rate, improvements are also being made in air navigation and traffic control. The effect of these developments will be to substantially increase the air traffic capacity of airports and air-space.

The Federal Aviation Agency is in the process of developing the National Air Space Utilization System. This is a program to extend the use of radar and computer techniques to obtain more effective control over aircraft movements, to increase the number of aircraft a controller can safely handle at one time, to permit closer spacing of aircraft in terminal air-space, and to increase the acceptance capacity of large airports. As part of this program in the Bay Area, a common instrument flight control room is being established at Oakland Airport to control all IFR (Instrument Flight Rules) operations, which include nearly all air commerce and some general aviation flights, in the San Francisco Bay Area regardless of which airport the airplane uses.

New low-cost instrument landing systems have been developed which should make possible installation at many small and medium-size airports and on more than one runway at busy airports.

The growth of air traffic and the demands of new kinds of aircraft are causing airport designers to examine radical departures from conventional airport layout. Two new designs have been in

the news lately. The United States Navy has been testing a concept employing a completely circular runway.^{7/} The main runway, under the proposed design, would be in the form of a banked track and would form a perfectly circular perimeter around the airport. At the very center would be the control tower, which would have an unobstructed view of every portion of the runway. The passenger terminal would also be circular, ringing the control tower. The entire outer wall of the terminal would face the runway, providing the maximum number of aircraft loading positions. The aircraft loading area would be connected with the runway by taxiways and high-speed turnoff ramps, arranged like spokes in a wheel.

The result would provide aircraft with an infinitely long runway. Such an airport would require far less acreage than a conventional airport handling the same amount of air traffic. The Navy tests indicated that pilots had no trouble adjusting to the circular runway, which, with a diameter of 10,000 feet, would have an effective length of 32,000 feet.

A floating airport has been proposed for Osaka Bay, Japan. The one-runway airport would be located between the cities of Kobe and Osaka off the shores of one of the country's most densely populated sections. As proposed, the airport would resemble a "T" with a thick stem. It would consist of two connected sections with a total area of 740 acres. The top of the "T" would contain

^{7/} "Circular Airport Proposed by Navy," The New York Times, December 13, 1965

a 13,000-foot runway and a taxiway of the same length. The second section would house the hangars and visitors' platform on the deck, and offices, terminal and fuel storage facilities below the deck. Both sections would be 30 feet above the water. The airport would be held in place by anchors.

Factors Affecting Air Travel Demand

The demand for air transportation is essentially a "derived demand." Generally, people do not fly for the sake of flying but as a means of accomplishing some other personal or business objective. The few studies done in this field have pointed out certain factors which have significant effect on air travel demand for a region as a whole and within a region as well. The most important of these are population size, level of economic activity, and travel costs.

The single most important factor determining air travel demand is population: other things being equal, the greater the number of people in an area, the greater will be the demand for air transportation there. It follows from this that the higher the population of two regions, the greater will be the volume of travel between them. Within a region, those communities and areas having the greatest population will generate the greatest number of air travelers.

Economic activity and population are closely related. In general, the higher the level of economic activity in a region the greater will be the level of air transport activity there. Where

the economy of a region depends to a substantial extent on the importing and exporting of goods and services with other areas a long distance away (as is the case in the Bay Area), air travel demand is especially high. The ability of businessmen in a particular area to compete effectively for access to and control over markets in other areas depends to a large extent on the ability of available transportation to link the areas involved. The speed of air transportation is often the one factor which makes effective competition possible.

The cost of air transportation, in terms of frequency of service, actual cash outlays, and total door-to-door travel time expended, has a significant effect on demand. Put another way, the more convenient it is to travel or to ship by air, the greater the demand for it will be. The important point here is that demand is a function of door-to-door, not airport-to-airport costs; thus location of and access to airports are as important as airport service itself. The importance of relative cost as a factor influencing travel demand for a particular mode can be illustrated by the spectacular rise in air cargo tonnage in recent years. This rise coincided with a decrease in relative cost of air freight compared to surface freight.

These factors are closely interrelated. Only by analyzing them together is it possible to predict with accuracy the total air transportation demand in a region; to evaluate alternative airport sites; or to allocate air travel demand among airports within a region.

Air Transport Facilities

Since air journeys begin and end there, the airport may be regarded as the heart of the air transport system. It is through their airports that communities obtain access to the national and international air transport systems; and the location and design of airports largely determines the extent to which communities benefit from air transportation. The essential task of an airport is to effect the transfer of passengers and cargo between air vehicles and between air and surface transportation.

There are five basic constraints on airport capacity: terminal building capacity, air-space capacity, runway capacity, terminal access capacity, and auto parking capacity. The weakest of these five "links" determines the actual capacity of the airport. Auto parking can be as serious a limitation as runway length; and overcrowded freeways are as important as too few aircraft gate positions.

The previous sections have pointed out that air traffic is growing rapidly and that the scope of air transportation is becoming much broader. No single airport or airport type can satisfy all the aviation needs of a metropolitan area. Generally, a regional airport system should include facilities for four types of air traffic: transcontinental and international flights; short- and medium-distance air carrier flights; helicopter and, soon, V/STOL flights; and general aviation activity. Each of these

requires facilities having particular location and design characteristics. All should be planned as complementary elements in an airport system for the region.

1. Transcontinental and International Air Traffic

The "world class" airports serve the largest geographic area. Because of the size of the area served and because door-to-airport time is least significant on long-distance flights, location close to a particular city center is less important for this type of airport than is accessibility from all parts of the region. Planning for this type of facility cannot be separated from planning for regional highway, transit, and special support transportation.

This airport must be able to accommodate the largest and most sophisticated aircraft. A very large area of land is usually required: the newest of these, Dulles Airport in Washington, has a 10,000 acre site. Most of the world's international airports are considerably smaller than this. (See Table 3.) For long-range airport planning a site of 15,000 acres may be desirable. Ordinarily, one airport of this type is sufficient to serve a metropolitan area.

Compared to short- and medium-distance flights, the number of transcontinental and international flights generated by a metropolitan area is small. The cost of building and operating an airport reserved solely for these flights is in most cases prohibitive. Therefore, a certain number of shorter flights can and

TABLE 3

COMPARISON OF PASSENGER TRAFFIC, LAND AREA AND
RUNWAY LENGTH OF SELECTED WORLD AIRPORTS

Airport	Passengers Handled 1962 (millions)	Area (acres)	Longest Runway(ft.)
Amsterdam	1.5	2,100	10,827
Copenhagen	2.2	1,680	11,000
Frankfurt	3.0	2,520	12,790
London (Gatwick)	1.0	620	7,000
London (Heathrow)	8.1 (1963)	2,705	11,000
Los Angeles International	9.1 (1963)	3,000	12,000
Milan	1.1	781	7,337
New York (Kennedy)	11.5	4,900	14,600
Paris (Le Bourget)	1.0	1,482	9,840
Paris (Orly)	3.5	2,668	10,892
Rome	2.4	3,840	12,800
San Francisco International	6.3	2,200	10,600
Tokyo	2.4	860	9,850
Washington (Dulles)	1.2	10,000	11,500
Zurich	1.8	1,173	8,200

Source: Roy Allen, Great Airports of the World, Ian Allen, London, 1964. For San Francisco Airport: San Francisco Public Utilities Commission

should be assigned to such an airport as a convenience for connecting passengers and nearby communities. However, the main function of the airport should not be impaired by unnecessary traffic that could use other facilities.

2. Short- and Medium-Haul Facilities

Ground-access time, and therefore airport location with respect to centers of population and economic activity, becomes increasingly important as flight time decreases. Since the majority of air carrier flights from metropolitan areas are less than 1000 miles in length, it is most desirable to bring these flights as close to passenger and cargo destinations as possible. Because of the large number of short-haul flights, a single metropolitan area can generally support more than one airport of this type. Each can be located so as to serve a portion of the total market area.

Since the Electras, 727's, Caravelles, and the new short-haul jets can use runways of 6,000 feet, these airports require much smaller areas than a long-distance one. To accommodate two sets of 11,000 foot runways intersecting at essentially right angles requires nearly three times as much land as a similar configuration of 6,000 foot runways. About 1.3 square miles or 830 acres, is required for the shorter runways, not including clear zones, etc., against 4.3 square miles or 2,750 acres for the 11,000-foot configuration. Taxi distances are less on smaller fields, which is a consideration of some importance in the expense of jet operation.

Other things being equal, a small airport, i.e., one with shorter runways, can handle essentially the same number of flights as a large field.^{8/} Therefore, if more smaller airports can be made available because of less demand for land, the total flight handling capacity of the area is increased.

Not all of these airports will be small ones, however. Those serving large populations may need to handle the "stretched" jets, and so would require the long runways and other facilities to accommodate them.

3. Heliports and V-ports

Helicopter service will become increasingly important as a link between population centers and major airports, and also as a mode of intra-regional travel. Heliports can be considered as stations in a regional air rapid transit system. Like surface transit stations, heliports should be located in the heart of activity centers convenient to other modes of transport. "Transportation centers" which are stations for rapid transit, buses, helicopters, and which also have extensive parking facilities, are included in many urban general plans today. The roofs of parking garages are usually well-suited for heliports. The downtown

^{8/} Richard H. Jordan, "Airport Location in Relation to Urban Transport," Paper presented at annual convention of the American Society of Civil Engineers, New York City, October 1961, p. 14

Oakland heliport is a good example of this kind of facility. The capital cost of heliports ranges from \$150,000 to \$500,000, depending on location.^{9/}

A STOL port requires at least a 1,500-foot runway and would need 10 acres for a small port with three or four gates. A VTOL port with three gates would require about three acres of land. If placed in a city center, a moderately-sized VTOL port with six to eight gates would need six to seven acres and could cost from \$5 million to \$70 million, depending on land values. If elevated so that the underlying land could be used for other purposes, the cost could be as low as \$4 million to \$6 million.^{10/}

A city center air terminal, whether VTOL or STOL, must provide the facilities of a normal airport, including passenger-processing and equipment maintenance. Possible VTOL port locations are over parking garages, highways, railroad terminals and yards, and waterfront piers and docks. The latter have the advantage of permitting takeoffs and landings over water, thus reducing noise and annoyance to nearby land users. The noise problem is especially serious

^{9/} Stanford Research Institute, Air Terminal Requirements in California through 1975, Report prepared for California State Office of Planning, January 1966, p. IV-74. This report does not necessarily reflect the opinions or policy of the State Office of Planning.

^{10/} Ibid., p. IV-76

in the case of both helicopters and V/STOL aircraft. Not only do close-in sites make noise more noticeable, these aircraft are much noisier than conventional aircraft of similar size.

4. General Aviation Airports

The exclusive air commerce airport really does not exist. Federal law requires that facilities at all FAA-assisted airports be available to all aircraft equipped to use them. In 1965 general aviation accounted for 18% of the aircraft operations at San Francisco International, the busiest air commerce airport in the Bay Area.^{11/} Airport managements and general aviation pilots admit that this mixture of traffic is a very undesirable situation, but until more convenient general aviation facilities are available close to fliers' destinations there is no alternative.

Business flights require airports convenient to business centers, which are usually the areas where suitable sites are most scarce. Land requirements are small compared to air commerce airports: 3,000-foot runways are usually sufficient. Depending on location and function, a site of from 100 to 400 acres is usually needed. Exclusive business airports may need less. Clear zones and obstruction-free areas in the takeoff and landing patterns are required in all cases. Ideally, there should be a general aviation

^{11/} U.S. Federal Aviation Agency, FAA Air Traffic Activity, CY-65, Washington, D.C., 1966, Table 4

airport convenient to each major center of business activity in a metropolitan area. A number of industrial parks around the country have airports. The Sky West Air Industrial Park now being developed at the Hayward Air Terminal is an example.

Airports are needed for other general aviation uses, such as flying schools and general pleasure flying. Much of this need can be satisfied by private enterprise, but should be recognized when planning airport facilities for a region.

Airports As Part of a Regional Transportation System

Although each type of facility is intended to serve a particular segment of air transportation demand, they are highly interdependent. For example, a shortage of general aviation airports will result in an undesirable mixture of traffic and heavy demands at air commerce facilities. When airports are located close together as in the Bay Area, they share the same limited air-space and, from an air traffic standpoint, constitute one large airport with several runways. Therefore, it is important when studying airport requirements to consider all facilities in a given service area as part of an air transportation system.

Just as airports give a community and a region air access to other communities and regions, other elements in the local transportation system provide access to and from airports for various parts of the community. Airports, particularly commercial ones,

place' heavy demands on access highways and transit systems. The adequacy of or need for road access should be a prime consideration in assessing airport locations and expansion plans, and also in planning a metropolitan transportation system.

A Mixed Blessing

Although nearly everyone in a community or metropolitan area benefits to some degree from modern air transportation, the proportion of the population that actually uses the air transport system is relatively small; the ratio of passengers per year to local population is approaching 1:1 in some metropolitan areas, but this probably reflects more frequent flying by relatively few people more than an increasing proportion of the population flying: only about 40% of the U. S. population has flown in a commercial aircraft.

For the many people who fly infrequently or not at all, enthusiasm for the growing popularity of air travel is tempered by concern for the rising costs of maintaining public airports; the seemingly insatiable demands of airports for scarce land and, in the case of the Bay Area, water area; and the noise and other compatibility problems associated with airports.

1. Rising Costs

Stanford Research Institute estimates that the principal California air commerce airports intend to spend more than \$230 million on capital improvements to cope with their estimated 1975

traffic requirements.^{12/} Beyond 1975 the operators of one airport, San Francisco International, plan a major expansion costing about \$280 million. This is an enormous financial burden for a city of 750,000 people.

Yet San Francisco International is one of the most prosperous airports in California. A California Legislature Committee on Transportation found that:

"Few airports [in California] are able to develop adequate revenues to cover more than operating expenses and capital improvements must either be deferred or paid by the local taxpayer. . . . Most of those general aviation airports showing a profit and many at the 'break even' point obtain a large share of their revenues from non-aviation sources, such as agricultural or industrial leases, concessionaires, restaurants, etc."^{13/}

Airports are competing with schools, open space, highways and other needs for local support. The person who never flies may understandably wonder whether the airport is worth the investment.

^{12/} Stanford Research Institute, op. cit., p. II-6

^{13/} California Legislature, Assembly Committee on Transportation and Commerce and Senate Fact Finding Committee on Transportation and Public Utilities, Preliminary Report on California Airport Development and Other Aviation Matters, 1964, p. 15

2. Demands for Land

Land is a scarce resource in metropolitan areas. Any use, public or private, which requires a few acres in the heart of a central business district or several thousand acres convenient to principal transportation routes, will have difficulty finding a suitable site. If this use is a magnet for industrial and commercial development it will find physical expansion difficult as well. This is the problem facing most airports today.

Because airports are used by a relatively small proportion of a local population, many people cannot understand why they must occupy sites which would otherwise be suitable for housing, parks, or some other badly-needed facility. In addition, a busy airport always seems to need more and more land. To secure the needed land, houses and business establishments must be condemned or water areas must be filled; neither action is likely to increase the airport's popularity in the community.

3. Noise

Modern airplanes are improvements over their predecessors in nearly all respects except one: noise. Aircraft are noisier than ever and there is no evidence of a reversal of this trend. Helicopters are very noisy and preliminary studies indicate that V/STOL aircraft will be much noisier than conventional aircraft of similar

size. The stretched and supersonic transports will certainly be noisier than airliners now in use. The coming of executive and short-haul jets to smaller airports will introduce the noise problem to many communities heretofore spared.

Very few people consider aircraft noise a pleasant sound, but the level at which it becomes annoying or intolerable varies widely among individuals. Some persons adjust to the noise easily; others do not. Attitudes toward the noise vary as well: some people accept it as the price of progress; others have appealed successfully for property tax-relief and obtained damages against airports because of it.

While there are indications of increasing concern about aircraft noise in the aviation industry, a reversal of the trend toward noisier aircraft is unlikely in the foreseeable future. A recent report on jet aircraft noise by the United States Office of Science and Technology noted that:

"In general it is technically possible to suppress the noise of an exhaust jet; however, it is very costly in terms of percent of aircraft gross weight and installed hardware. The former is true of both present and future aircraft and increases exponentially with the amount of suppression achieved. The latter is

particularly true for existing vehicles. . . . In spite of extensive industry- and Government-sponsored research there appears to be no technical avenue for achieving major improvements in engine noise suppression which now appears economically feasible. . . ."^{14/}

SUMMARY

All phases of civil aviation are growing at a rapid rate, and there is no sign of their slowing down. Continuing technological progress in the aviation industry and changing economic conditions are making air transportation more attractive to more people for more purposes. The ever-broadening range of aircraft types and uses require more kinds of terminal facilities, which will in turn require heavy public investment and sound long-range planning in order that the maximum benefits of air transportation be realized and disruptive effects kept to a minimum.

^{14/} United States Office of Science and Technology, Executive Office of the President, Alleviation of Jet Aircraft Noise Near Airports, Report of the Jet Aircraft Noise Panel, Washington, D.C., March 1966, pp. 5-6

PART II. AIR TRANSPORTATION IN THE
SAN FRANCISCO BAY AREA

Air transportation in the Bay Area has come a long way since the late 1920's, when the San Francisco Board of Supervisors and the Oakland Board of Port Commissioners chose sites at the Mills Estate in San Mateo County and on Bay Farm Island in Oakland, respectively, for municipal airports. The 490-passenger Boeing 747's that will soon be calling at local airports are a far cry from the "giant" 32-passenger Boeing Patrician that Col. Charles Lindbergh ran into the mud at Mills Field in 1929. Will Rogers, arriving at Oakland Airport about the same time, exclaimed:

"Man alive! Look at all those airplanes. Land sakes!
What a lot of activity all in one place!"

The activity he saw was but a small fraction of what can be seen there now.

Today the San Francisco Bay Area is one of the busiest air transportation hubs in the world. It is a principal western node of the national air transport system, and the major northern node of the California air transportation "corridor" extending from Sacramento to San Diego. The Bay Area-Los Angeles leg of this corridor is the busiest air route in the world. There is every reason to expect that the Bay Area will realize a substantial share of the anticipated national and state growth in air transportation.

Bay Area Air Traffic

In 1965 there were nearly 1.4 million aircraft takeoffs and landings at the seven principal Bay Area civilian airports. About 1/5 of these were air carrier operations, which accounted for more than 10 million passengers. Airline passenger traffic in the Bay Area is currently increasing by more than 10% per year. Figure 3 illustrates what the future holds if this rate of growth continues. Air cargo tonnage handled at Bay Area airports in 1964 totaled more than 60,000 tons^{1/}, and is increasing by about 45% per year. Per capita use of passenger air travel in the San Francisco Regional Airport Service Area rose from 308.8 enplanements per 1,000 population in 1953 to 694 per 1,000 population in 1963 and is still rising^{2/}. By 1975 enplanements per capita could reach 1,400 per 1,000 population^{3/}.

Table 4 shows that in terms of aircraft operations, San Jose Municipal Airport is the busiest airport in the Bay Area, accounting for more than 22% of all takeoffs and landings at the principal

1/ United States Civil Aeronautics Board and Federal Aviation Agency, Airport Activity Statistics of Certificated Route Carriers CY-64, Washington, D. C., 1965. p. 13

2/ Stanford Research Institute, Air Terminal Requirements in California Through 1975, prepared for California State Office of Planning, January 1966. p. IV-41. The San Francisco Regional Airport Service Area as defined in that report includes the nine Bay Area counties plus Santa Cruz, San Joaquin, and Stanislaus Counties. This report does not necessarily reflect the opinions or policy of the State Office of Planning.

3/ Ibid., Table IV-2

FIGURE 3

Projected
Enplaned
Air Passengers
for
San Francisco
Regional Airport
Service Area*

Source:
1953-63 data
and estimates
to 1975
Stanford Research
Institute
Air Terminal
Requirements
in California
through 1975
Prepared for
California
State Office of
Planning
January 1966.
1990 projection
indicative only.

*San Francisco
Regional Airport
Service Area
includes nine
Bay Area counties
+ Santa Cruz,
San Joaquin, &
Stanislaus Counties

Enplaned passengers
in millions
United States Flag
carriers only

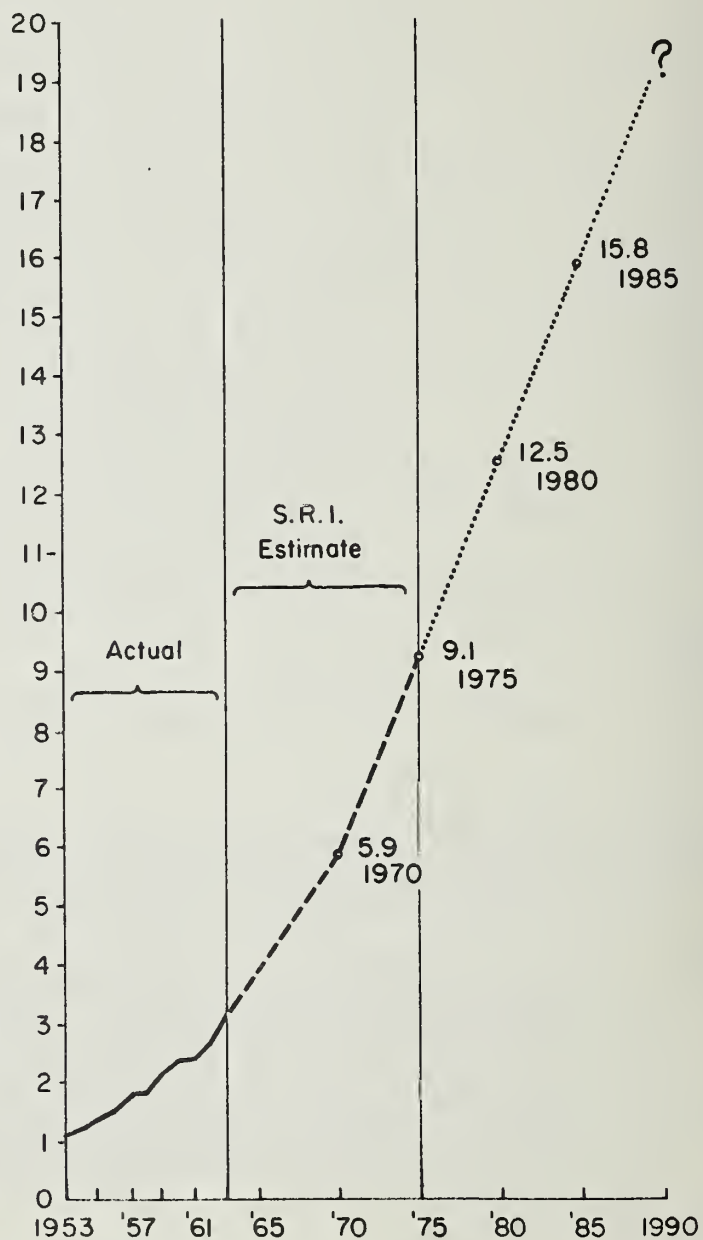


TABLE 4

AIRCRAFT OPERATIONS AT FAA-OPERATED AIRPORT CONTROL
TOWERS IN THE BAY AREA, 1965

Airport	Air Carrier	General Aviation	Military	Total
Concord	8 (- %) (- %)	233,479 (99.7%) (21.5%)	659 (0.3%) (2.1%)	234,146 (100.0%) (16.9%)
Hayward	4 (- %) (- %)	194,598 (96.0%) (17.9%)	8,080 (4.0%) (26.3%)	202,682 (100.0%) (14.6%)
Napa County	2 (- %) (- %)	36,470 (98.6%) (3.4%)	509 (1.4%) (1.7%)	36,981 (100.0%) (2.7%)
Oakland International	46,484 (16.0%) (17.2%)	230,523 (79.6%) (21.2%)	12,753 (4.4%) (41.6%)	289,760 (100.0%) (20.9%)
San Francisco International	210,948 (79.5%) (77.9%)	48,927 (18.4%) (4.5%)	5,571 (2.1%) (18.1%)	265,446 (100.0%) (19.1%)
San Jose	10,912 (3.6%) (4.0%)	294,038 (95.7%) (27.0%)	2,283 (0.7%) (7.4%)	307,233 (100.0%) (22.1%)
Santa Rosa	2,516 (4.8%) (0.9%)	48,736 (93.5%) (4.5%)	866 (1.7%) (2.8%)	52,118 (100.0%) (3.7%)
BAY AREA TOTAL	270,774 (19.5%) (100.0%)	1,086,771 (78.3%) (100.0%)	30,721 (2.2%) (100.0%)	1,388,366 (100.0%) (100.0%)
State Total	780,216 (13.3%)	4,834,848 (82.4%)	255,399 (4.3%)	5,870,463 (100.0%)
Bay Area as % of State	(34.7%)	(22.4%)	(12.0%)	(23.7%)

Source: U. S. Federal Aviation Agency, FAA Air Traffic Activity, CY-65, Table 4

airports. It also had the largest number of general aviation operations in 1965, 294,000. Meanwhile, San Francisco International handled 211,000 air carrier operations in the same year, 78% of the air carrier total.

The airways above the Bay Area are also very busy. This is especially true around the South Bay, where several airports are located very close together. Federal Aviation Agency traffic management techniques are keeping up with traffic growth, however, so that airway "congestion" is not likely to be a serious limitation on airport capacity in the immediate future. It will limit the number of new airports that can be built in the South Bay Area, however. In contrast to this, there is considerable surplus "airspace" in the North Bay Area.

Air Transportation and the Bay Area Economy

There have been no definitive studies of the effects of air transportation on the Bay Area economy, but enough is known to indicate that the benefits are substantial. The benefits are realized first in the direct employment and purchases by airports, airlines, commercial aviation service operators, military aviation, and other public and private suppliers of air transport services. Employment at the 34 Bay Area airports is estimated at 35,000, excluding military personnel^{4/}. Aggregate outlays for salaries and wages and

^{4/} Institute of Transportation and Traffic Engineering, University of California, Berkeley, Preliminary Prospectus, San Francisco Bay Area Regional Airport Study, Draft prepared for discussion. September 1965, p. 1

purchases of materials and supplies of these airports amounts to billions of dollars annually. San Francisco International alone has more than 20,000 workers with an aggregate payroll of nearly \$160 million^{5/}.

Of even greater importance, however, is the higher level of economic activity made possible in the Bay Area by the availability of good air transportation. Accessibility to distant markets is essential to Bay Area trade, and good inter-regional air transportation can compensate for the disadvantage of physical distance between the Bay Area and other population centers. The Bay Area is a major tourist and convention center, and an increasing proportion of these visitors are arriving by air. Vice President Hubert Humphrey, quoted in the Federal Aviation Agency's 1965 National Airport Plan, summed up the value of air transportation to a metropolitan area as follows: "First-rate airport facilities in a metropolitan area is a matter not merely of civic pride but of economic necessity. Those without it are at a grievous disadvantage."

Federal recognition of the importance of air transportation to economic development is evidenced by the recent \$11 million grant-loan to the Oakland Board of Port Commissioners for airport improvements. The funds were provided by the Economic Development Act of 1965, which is designed to stimulate economic growth and

^{5/} San Francisco Public Utilities Commission, Annual Report 1964-1965, p. 5

jobs in areas of high, long-term unemployment. The money will be used to build hangars and maintenance facilities for the "stretched" jets and a cargo terminal.

Although the economic well-being of the Bay Area is certainly influenced by air transportation, there is a real need for closer study of this relationship. The effect of incremental improvements or changes at particular airports is still largely a matter of opinion. For example, no one really knows what would happen to the local economy if supersonic transports were prohibited from using airports here; or what economic benefits would result from the introduction of non-stop flights to Europe. It is possible that the economic benefits from these kinds of improvements may not justify the public investment. At present there is no convincing evidence one way or the other. Put another way, while "first-class" air transportation is essential to the economic well-being of the Bay Area, what is meant by "first-class" and how can it best be achieved?

Airports in the Bay Area

There are 30 public-use airports in the nine-county Bay Area. These are described in Table 5. Fourteen of these airports are privately owned; the remainder are owned by cities and/or counties. In addition, there are eight heliports, including those at the principal airports, which are used by SFO Helicopter Airlines.

The National Airport Plan is prepared annually by the United States Federal Aviation Agency. It lists "in terms of general

BAY AREA PUBLIC-USE AIRPORT DATA

County	Airport	Nearest Town	Ownership	Air Carrier Service	Longest Runway (feet)	Land area (acres)
Alameda	Alameda NAS	Alameda	Military	---	8,000	N.A.
	Fremont Sky Sailing	Fremont	Private	---	1,840	25
	Hayward Municipal	Hayward	Municipal	---	5,250	710
	King Skylandes	Fremont	Private	---	2,300✓	89 —
	Livermore Sky Ranch	Livermore	Municipal	---	4,000	250
	Oakland International	Oakland	Municipal	X	10,000	1,485
Contra Costa	Antioch	Antioch	Private	---	2,503✓	40 ★
	Buchanan Field	Concord	County	---	5,000	750
Marin	Hamilton AFB	San Rafael	Military	---	N.A.	2,185
	Marin County	Novato	County	---	3,000	25
Napa	Angwin	Angwin	Private	---	2,870✓	N.A.
	Calistoga Airpark	Calistoga	Municipal	---	2,670	25
	Napa County	Napa	County	---	5,332	735
San Francisco	Crissy Field (Presidio)	San Francisco	Military	---	2,900	40
San Mateo	Half Moon Bay	Half Moon Bay	County	---	5,000	217
	San Carlos	San Carlos	Private	---	2,500✓	71 ★
	San Francisco Intl	San Francisco	Municipal	X	9,700	2,200
Santa Clara	Moffett Field NAS	Mtn View	Military	---	9,200	1,775
	Morgan Hill	Morgan Hill	Private	---	2,430	10
	Palo Alto	Palo Alto	County	---	2,500	162 ★
	Reid's Hillview	San Jose	Private	---	2,700✓	185
	San Jose Municipal	San Jose	Municipal	X	7,787	1,000
Solano	Nut Tree	Vacaville	Private	---	2,500	50 ★
	Rio Vista Municipal	Rio Vista	Municipal	---	2,810	109
	Travis AFB	Fairfield	Military	---	N.A.	6,073
	Tremont	Tremont	Private	---	2,200	170 —
	Vaca-Dixon	Vacaville	Private	---	2,300	N.A. —
	Vacaville	Vacaville	Private	---	2,100	75 —
Sonoma	Bodega Bay	Bodega Bay	County	---	N.A.	N.A.
	Cloverdale	Cloverdale	County	---	2,800	58
	Coddington	Santa Rosa	Private	---	3,250	23
	Healdsburg Municipal	Healdsburg	Municipal	---	2,040	30 —
	Petaluma Sky Ranch	Petaluma	Private	---	1,900	22 —
	Sonoma County	Santa Rosa	County	X	5,003	940
	Sonoma Valley	Schellville	Private	---	2,900✓	73

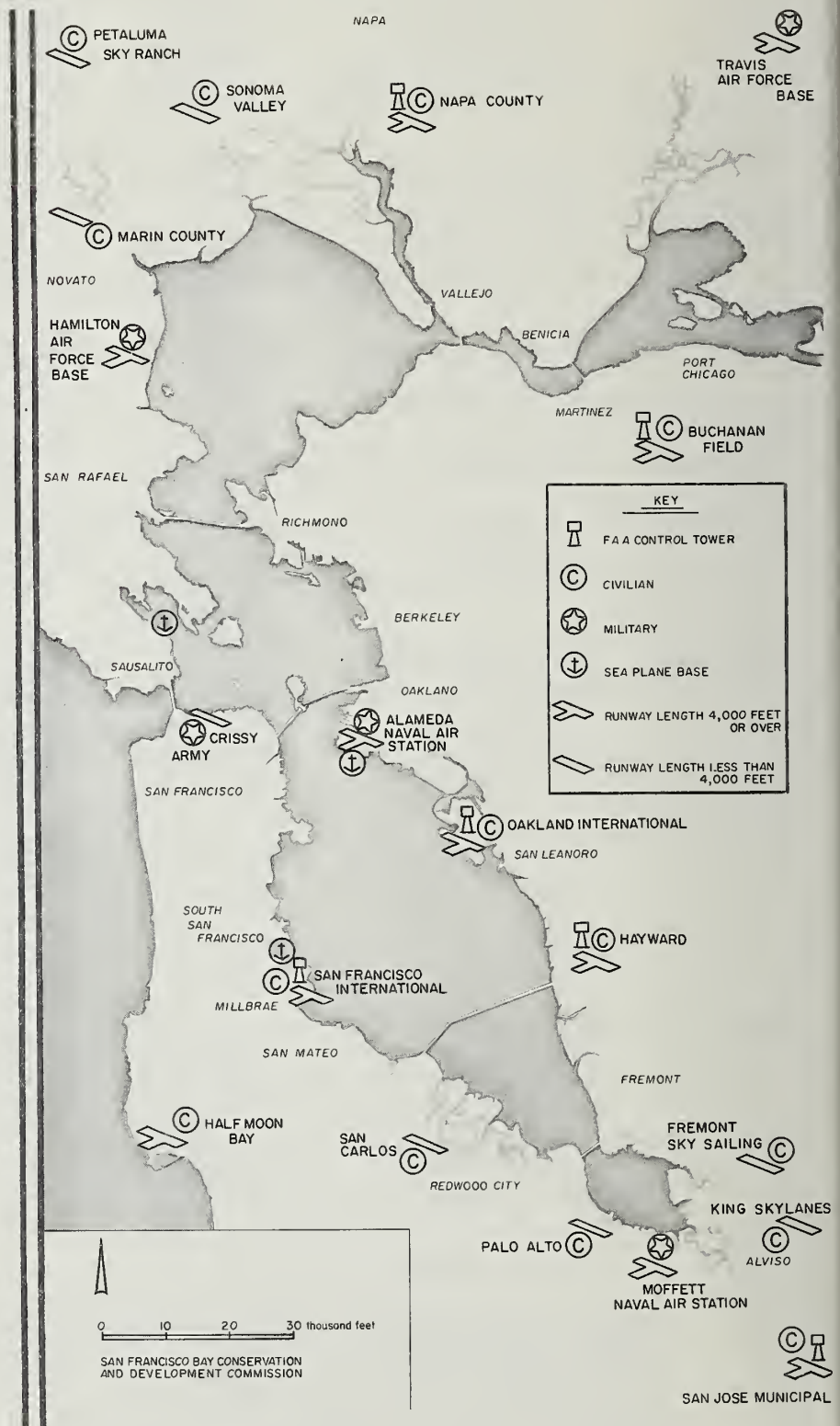
Sources: Walter E. Gillfillan, California General Aviation: Airports, Aircraft, & Flight Activity, University of California, Institute of Transportation & Traffic Engineering, June 1961.

U. S. Department of Commerce, Coast & Geodetic Survey, San Francisco Local Aeronautical Chart, Washington, D. C., January 1965.

California, Senate Permanent Fact Finding Committee on Natural Resources, Third Progress Report, Section II, Public Land Ownership and Use in California, 1965.

FIGURE

Bay Area
Airports
1966



location and type of airport development the projects considered to be necessary to provide a system of public airports adequate to anticipate and meet the needs of civil aeronautics." The FAA National Airport Plan for 1965 lists 16 of the existing Bay Area airports and 3 heliports. It proposes that 7 new airports and 9 new heliports be constructed to meet forecasted 1970 air traffic needs. Local needs may be greater than the FAA plan suggests. The National Airport Plan proposals for the Bay Area are summarized in Table 6.

The NAP does not list projects in order of priority, nor does it take into account the resources of a community in proposing projects. The inclusion of a project in the NAP does not necessarily imply that Federal aid will be available for it. The plan is developed in cooperation with the State Division of Aeronautics and local airport operators, and is a useful indicator of short-range deficiencies. It is not, nor is it intended to be, a regional airport system plan.

TABLE 6

FAA 1965 NATIONAL AIRPORT PLAN
PROPOSALS FOR SAN FRANCISCO BAY AREA, 1966-1970

Community	Airport Name	Recommended Runway	Aeronautical Function	Recommended Development
I. AIRPORTS				
Antioch	Antioch	Basic Utility ^{1/}	Gen. Aviation-Business	Construct new airport
Berkeley-Richmond	New	General Utility ^{2/}	Gen. Aviation-Business	Construct new airport
Cloverdale	Cloverdale Municipal	Basic Utility	Gen. Aviation-Business	Minor improvements
Concord	Buchanan Field	Larger than General Utility ^{3/}	Gen. Aviation-Business	Major improvements
Fremont	New	General Utility	Gen. Aviation-Business	Construct new airport
Half Moon Bay	Half Moon Bay	Larger than G. U.	Gen. Aviation-Business	Minor improvements
Hayward	Hayward Air Terminal	Larger than G. U.	Gen. Aviation-Business	Major improvements
Livermore	Livermore Municipal	Larger than G. U.	Gen. Aviation-Business	Minor improvements
Morgan Hill	Morgan Hill	Basic Utility	Gen. Aviation-Commercial	Construct new airport
Napa	Napa County	Larger than G. U.	Gen. Aviation-Business	Minor improvements
Novato	Marin County	General Utility	Gen. Aviation-Business	Construct new airport
Oakland	Metropolitan Oakland International	10,000-11,000 ft.	Trunk, International and Territorial Carriers	Minor improvements
Palo Alto	Santa Clara County	Basic Utility	Gen. Aviation-Business	Major improvements
Petaluma	Petaluma Sky Ranch	Basic Utility	Gen. Aviation-Commercial	Minor improvements
Rio Vista	Rio Vista Municipal	Basic Utility	Gen. Aviation-Business	Major improvements
San Carlos	San Carlos	Basic Utility	Gen. Aviation-Business	Major improvements
San Francisco	San Francisco International	10,000-11,000 ft.	Trunk, International and Territorial Carriers	Major improvements
San Francisco	New	Basic Utility	Gen. Aviation-Business	Construct new airport
San Jose	Reid Hillview	Basic Utility	Gen. Aviation-Business	Major improvements
San Jose	San Jose Municipal	6,000-7,000 ft.	Local Service	Minor improvements
Santa Rosa	Sonoma County	5,000-6,000 ft.	Local Service	Minor improvements
Sausalito	Command Seaplane Base	---	Gen. Aviation-Commercial	Major improvements
Vacaville-Fairfield	Vacaville	Basic Utility	Gen. Aviation-Commercial	Construct new airport

Community	Airport Name	Recommended Runway	Aeronautical Function	Recommended Development
II. HELIPORTS				
Berkeley	Berkeley Municipal Heliport	---	Helicopter Carriers	None
Oakland	Exposition Parking ^{4/} Lot Heliport	---	Helicopter Carriers	None
Palo Alto	New	---	Helicopter Carriers	Construct new heliport
Pittsburg	New	---	Gen. Aviation-Business	Construct new heliport
Redwood City	New	---	Gen. Aviation-Business	Construct new heliport
Richmond	New	---	Gen. Aviation-Business	Construct new heliport
San Francisco	New	---	Helicopter Carriers	Construct new heliport
San Mateo	New	---	Gen. Aviation-Business	Construct new heliport
Sausalito	Marin County Heliport	---	Helicopter Carriers	Minor improvements
Sunnyvale	New	---	Helicopter Carriers	Construct new heliport
Vallejo	New	---	Gen. Aviation-Business	Construct new heliport
Walnut Creek	New	---	Helicopter Carriers	Construct new heliport

- 1/ Basic Utility - capable of accommodating 95% of the general aviation fleet, excepting a few large twin-engined aircraft over 8,000 lbs. gross weight and transport-type aircraft.
- 2/ General Utility - capable of accommodating all types of general aviation aircraft except transports.
- 3/ Larger than General Utility - capable of accommodating all types of general aviation aircraft.
- 4/ The Oakland Heliport has been moved to a downtown location.

Source: U. S. Federal Aviation Agency, National Airport Plan FY 1966-1970, Washington, D. C., 1965.

Future Plans of Principal Airports

The rapid increase of air traffic has been duly noted by managements of the major airports, and they are preparing development programs to meet it. The San Francisco Public Utilities Commission, which operates San Francisco International Airport, recently recommended that a \$95.5 million bond issue be placed on the November ballot. This would be used to double the airport's passenger handling capacity and to build new air cargo facilities. The PUC also intends to extend the airport runways to accommodate long-range flights and the "stretched" jets. This development program is expected to meet estimated 1975 needs. Longer-range plans include a completely new "regional airport" facility on land to be filled south of the existing airport, a new jet runway in the Bay, and other major improvements requiring a capital expenditure of more than \$280 million^{6/}. These improvements will enable the airport to handle 30 million passengers a year, 3 times its present traffic.

The Oakland Board of Port Commissioners plans to extend the jet runway 2,500 feet and to provide maintenance facilities at Oakland International Airport to accommodate the stretched and supersonic airliners. Air cargo facilities are also being increased and a major cargo distribution center has been proposed at

^{6/} Dreyfuss and Blackford, and Quinton Engineers, Ltd., Master Plan: San Francisco International Airport, Prepared for San Francisco Public Utilities Commission, July 1966, p. 68

a nearby industrial park. Under its present master plan, Oakland International Airport can be expanded to handle 10 million passengers a year, 10 times its present traffic. The airport is expected to be handling 10 million passengers a year by 1975. Two more jet runways parallel to, and 5,000 and 10,000 feet out in the Bay from, the present runway are included in the airport master plan. As at San Francisco, this expansion would require considerable Bay fill.

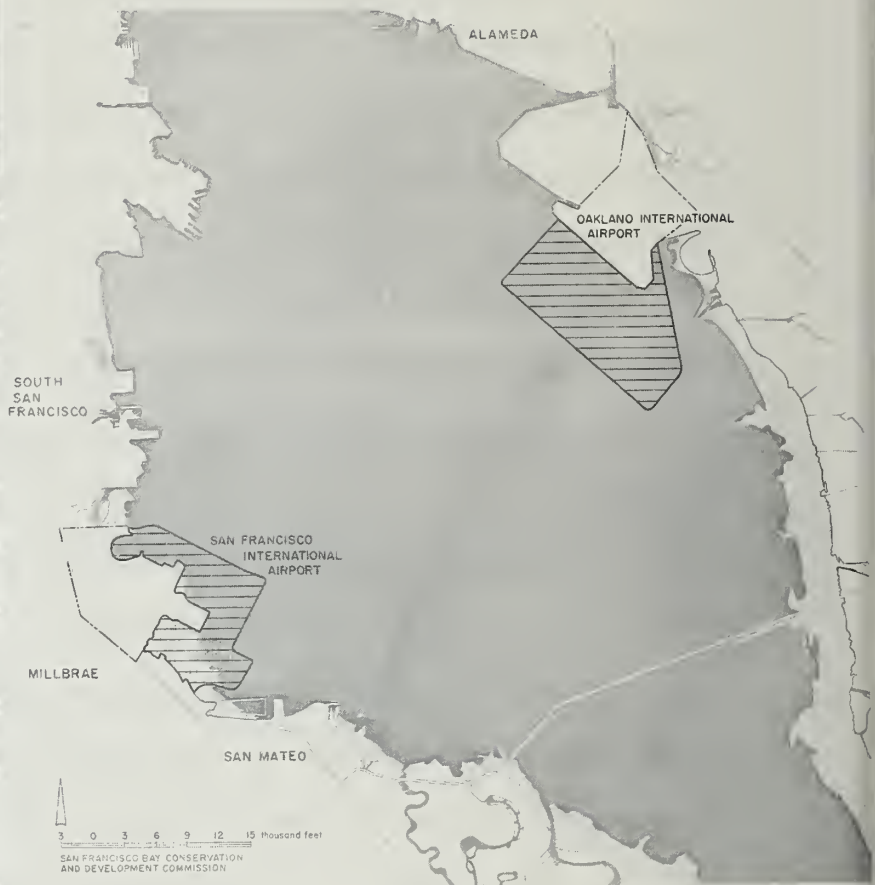
The general configuration of Bay fill included in the San Francisco and Oakland Airport Master Plans are shown in Figure 5. The configuration is based on each airport's estimate of its long-term needs.

Several improvements are planned for San Jose Municipal Airport, most of which are intended to increase its air carrier capacity. Parking, air terminal and runway expansion and the acquisition of land for clear zones are the major items in its program to 1975. Because it is located inland and close to the built-up area of San Jose, the airport cannot be expanded indefinitely. If a major air commerce airport is necessary in Santa Clara County, a new site will have to be found.

There are five active military airports in the Bay Area: Alameda and Moffett Naval Air Stations, Hamilton and Travis Air Force Bases, and Crissy Field in the San Francisco Presidio. These are shown on Figure 4. There are no plans for major expansion at any of these facilities. Although it is quite possible that one or more of them will eventually be declared surplus, the

FIGURE 5

Oakland and
San Francisco
Airport
Master Plans
General
Configuration
of
Bay Fills



Sources:

Oakland Board of Port Commissioners

Metropolitan Oakland International Airport:
Master Plan

August 31, 1960

Dreyfuss & Blackford & Quinton Engineers, Ltd.

Master Plan and Report, San Francisco
International Airport

June 1966

Department of Defense has not indicated that any will be closed in the near future.

Federal law provides that surplus United States real and personal property which is determined by the Administrator of the Federal Aviation Agency "to be suitable, essential or desirable for development, improvement, operation, or maintenance of a public airport ..., or reasonably necessary to fulfill the immediate and foreseeable future requirements of the grantee for development, operation, or maintenance of a public airport ..." can be conveyed to "any State, political subdivision, municipality or Tax-supported institution without monetary consideration to the United States."^{7/}

Moffett Field, Hamilton Field and Travis Air Force Base might be suitable for conversion to civil aviation use. Should any of these sites be made available for civil aviation, it would greatly ease the problem of developing new facilities.

Problems of Bay Area Airport Development

The problems which face airport managements in the Bay Area are not unique to this region. However, the peculiar combination of physical, political and financial conditions here make some of these problems especially critical. Among these critical problems

^{7/} Surplus Property Act of 1944, s13(g), 50 U.S.C. App. Supp. 1622 (g), as extended by Federal Property and Administration Services Act of 1949, s602(a), and amended by Public Law 311, 81st Congress, 50 U.S.C. App. 1622, (a-c). Summarized in United States General Services Administration, Disposal of Surplus Real Property, Washington, D. C., 1963, p. 16.

are long-range planning, financing needed improvements and land use control.

1. Long-Range Planning

The Stanford Research Institute study of California air terminal requirements concluded that "few [airport managements] have an accurate understanding of the needs of the geographic area they serve or the functions that users rely on them to provide."^{8/} This was not intended as criticism of the competence of airport operators; rather, it was a criticism of the context in which they must operate.

The San Francisco Bay Area is a single air travel market. It is possible to determine and evaluate the factors which influence travel demand in this market area and to predict the future rate of air traffic growth. As long as the regional market is viewed as a single entity, forecasting is a relatively simple process. However, at present this cannot be done.

As Table 5 indicates, there are thirty civilian airports in the nine-county Bay Area, each operated by a different agency or individual. Each airport operator is responsible to a small segment of the market area's citizens, and can expand and improve the airport only up to the amount which the citizens (as taxpayers or stockholders) permit. Each operator must "cut up" the market; there is no area-wide planning or research authority to allocate or guarantee shares. The operator's investment can be jeopardized by the unanticipated action of other airport operators and agencies

^{8/} Stanford Research Institute, op. cit., p. II-9

concerned with air transportation, and also by inaccurate estimation of demand at his facility, even if his estimate of total area demand was accurate.

The result of this situation is that two or more public agencies may be competing and spending money to attract the same traveler, shipper or aircraft operator; while a substantial segment of the market may not be adequately served.

2. Financial Problems

Rapidly changing technology and the overall increase in air traffic is putting a heavy financial strain on local airport operators. The Bay Area will need more general aviation airports and heliports; and, possibly, new air commerce airports and V/ports in the foreseeable future. Large capital expenditures will be needed at many existing airports.

Available evidence suggests that, in the long run, local governments and private airport operators will not be able to meet the capital costs which these operators believe are necessary to meet future needs. Either increased Federal or State aid must be made available, or airport planning and development must be put on a broader geographical and financial base. Both developments may prove to be necessary.

3. Land Use Control

According to State Director of Aeronautics Clyde Barnett, only one airport in California, Stockton Metropolitan, is adequately zoned for protection against incompatible uses and structures in

the surrounding area^{9/}. A study by the Institute of Transportation and Traffic Engineering at the University of California also noted that "many airports are without effective protection against encroachment ... by industrial, residential and other structures ..."^{10/}

None of the local airport administrations have authority to protect the airport from incompatible uses of land adjacent to the airport. The approach and departure patterns of nearly all Bay Area airports are over land that is under the jurisdiction of governmental units other than those responsible for the airport's adequacy. The most carefully thought-out and well-intentioned airport development plans can be and often are thwarted by the action of another agency which allows an incompatible land use pattern to develop around the airport or neglects to provide adequate access roads and other supporting facilities.

This problem is illustrated by the case of Oakland International Airport and the City of Alameda. The main runway of the airport was built on filled land some distance out into the Bay in order to secure over-water clear-zones for aircraft takeoffs and landings and also to minimize the noise problem. However, the area north of the runway is part of the City of Alameda, which

^{9/} California Legislature, Assembly Committee on Transportation and Commerce and Senate Fact Finding Committee on Transportation and Public Utilities, Preliminary Report on California Airport Development and Other Matters, 1964, p. 38

^{10/} Walter E. Gillfillan, California Airports: Facilities Inventory, Air Traffic and Land Use Protection, Special Report, Institute of Transportation and Traffic Engineering, University of California, Berkeley, February 1965, p. 24

recently approved the development of a large residential and commercial development to be built on filled land there. From the City of Alameda's standpoint there were good reasons for permitting the project; but the Port of Oakland may find itself liable for damages to future residents in the project even though the airport was there first.

Relation of Air Transportation to Other Aspects of Development

Not only does air transportation affect regional economic growth, airports are major determinants of local land use and traffic patterns. Proximity to airports is and will continue to be a major factor influencing many business and industrial location decisions. An airport acts as a "magnet" or stimulus for development in much the same way as a freeway interchange or rapid transit station, although on a larger scale. The industrial development on the San Francisco Peninsula would not have occurred as intensively or as quickly but for the presence of San Francisco Airport. According to Henry Bostwick, Jr., vice president and general manager of the San Mateo County Development Association, San Francisco Airport is "the major magnet" that draws industry to San Mateo County^{11/}. One of the objectives behind the Oakland Board of Port Commissioners' decision to expand Oakland Airport was to stimulate development of nearby industrial land and provide jobs for East Bay residents.

^{11/} "San Francisco Airport Called Key to San Mateo's Industrial Growth." San Francisco Daily Commercial News

On the other hand, airports have a negative effect on some land uses. Within metropolitan areas, airports are competing for scarce land which may be desirable for housing and recreational uses. The presence of an airport, particularly a large one, will usually repel such uses from occupying nearby sites while attracting more business-oriented activities. However, the degree of "repulsion" depends on the supply of land in the general area. Incompatible uses can and often do locate near airports when no other sites are available, usually to the detriment of all concerned.

Airports, particularly air commerce facilities, place heavy demands on access highways. Air cargo must be trucked to and from airports; most passengers must drive or be driven there; workers at the airport must come and go each day; innumerable service vehicles make pickups and deliveries. The result of all this, combined with the traffic generated by airport-oriented uses nearby, is a large number of vehicles entering and leaving an airport area.

Requirements for airport access highways, transit systems serving airports and specialized transportation services to and from airports must be considered as an integral part of airport planning as well as regional transportation planning.

To summarize, an airport can be used to direct, focus, guide and create a business and employment center and to stimulate area development and commerce. In a real sense an airport can be used

as a tool in regional planning^{12/}. Decisions to alter the pattern of air carrier service, to expand existing facilities or build new ones can have important implications for Bay Area regional development and should not be taken without considering these effects.

Agencies Concerned with Air Transportation in the Bay Area

Although most Bay Area airports are operated by local governments, the air transportation facilities and service here are the result of decisions made by several agencies at all levels of government. The Federal Government, through the Federal Aviation Agency, Civil Aeronautics Board and Department of Defense, exerts considerable influence. The California Division of Aeronautics and Public Utilities Commission also have an interest.

1. Federal Aviation Agency (FAA)

The FAA is primarily concerned with the adequacy and safety of airports and airspace. It provides and operates control towers and landing aids; operates flight service stations at some airports to provide information for general aviation operators; and gives technical assistance to airport operators, including the development of design standards for airports and terminal buildings. The agency makes forecasts of future aircraft activity and annually prepares the National Airport Plan which was discussed in a previous

^{12/} Leigh Fisher, Airport Consultant, "Airports Will Be Downtown By 1970!", Address to San Mateo Development Association, October 4, 1960.

section. At present it is administering the U. S. supersonic transport development program.

Under the Federal Airport Act, the FAA administers the Federal Aid to Airports Program. This provides funds for airport construction, usually about 50 percent on a matching-funds basis. The funds can be used for land acquisition, preparing sites, paving runways, Taxiways and aprons, and similar purposes. The FAA no longer advances funds for terminal building construction.

In the future Federal airport aid will be concentrated on airports where activities are essential to air commerce, including air carriers and air taxi operators. General aviation airports needed to relieve pressure on air commerce airports would also be eligible for assistance. There may be some withdrawal from airport aid in general, placing more responsibility on local managements. This will have serious implications for Bay Area airport development.

For instance, the building of the "new" Metropolitan Oakland International Airport was made possible by a Federal grant to match the \$10 million bond issue approved by Oakland voters in 1957. Without this kind of aid it is unlikely that a similar facility could be built by any Bay Area community. Development of the less profitable but equally necessary facilities such as heliports and general aviation airports will also suffer from a cutback in Federal aid.

2. Civil Aeronautics Board (CAB)

Whereas the FAA is primarily concerned with airports and airspace, the CAB focuses on the economic regulation of air carriers. The authority of the CAB extends to all inter-state air carriers including intra-state connecting carriers. It regulates rates and conditions of carriage, primarily to avoid uneconomic competition and discrimination between geographic points. The Board certifies air carriers to serve particular points and passes on the carrier's decision to serve through a particular airport. It suspends or deletes services and can combine service to two or more points.

Because of its jurisdiction over points served by air carriers, the CAB has the authority to review the adequacy of the carrier's service to a community. It has no direct responsibility for carriers' schedules, however, except from the standpoint of discrimination or adequacy. The Board has never clearly stated its policies on adequacy of service or the circumstances under which it will authorize or delete service.

The lack of definitive CAB standards and policy guides is a major barrier to effective air carrier airport planning. Airport inadequacy is an almost unquestioned basis for service suspension by the CAB, and has been a consideration in route proceedings. But airport operators, who have the responsibility for providing the multi-million dollar facilities to serve air carriers, lack the authority and the information required to decide whether or not they will be served by one, two, or no carriers or the points to

which service will or will not be offered^{13/}. The level of service is an important determinant of terminal and runway requirements.

3. Department of Defense

There are 5 major military airfields in the Bay Area operated by the Department of Defense. The future of these installations has an important bearing on future Bay Area airport needs. Although there is a long-term trend toward the reduction in the use of manned aircraft by all services, there is no information available on the timing of particular moves affecting local facilities.

4. State of California

Two State agencies are directly concerned with aviation, the Division of Aeronautics and the Public Utilities Commission. From an annual fund of about \$350,000, the Division of Aeronautics of the Department of Public Works grants assistance, on a matching funds basis, to publicly owned airports. The maximum grant is \$2,500 per airport regardless of need. The Division makes feasibility studies and offers advice to public and private airport operators on matters relating to airport development, and also sits with the FAA and Division of Highways to review airport and highway plans for possible conflicts. Finally, it distributes educational information and sponsors courses and clinics to promote knowledge of and to stimulate interest in aviation. It is also empowered to acquire and maintain existing airport facilities and to prepare a

^{13/} Stanford Research Institute, op. cit., p. IV-89

State airport plan, although lack of funds and staff preclude this at the present time.

The 1965 California Legislature added \$0.02 per gallon to the aviation fuel tax for most general aviation aircraft. The funds from this tax will be used for State grants to general aviation airport operators to help finance capital improvements. The grants will be made on a matching funds basis, although the formula for allocations has not yet been determined. The program will be administered by the State Aeronautics Commission.

The California Public Utilities Commission has jurisdiction over rates charged by intra-state commerce carrier operations, and the issuance of certificates of convenience and necessity for service between California points by intra-state airlines. The Commission also reviews proposals to install or enlarge airport facilities to insure that all utility services remain unimpaired.

5. Local Governments

Municipal and county governments affect air transportation in two very different ways. First, through their zoning power they control the use of land and hence must pass on the suitability of a given site for an airport. Equally important, they control the use of land in the vicinity of airports and so to some extent can act to protect the airport against incompatible uses.

The second effect is more direct. As Table 5 indicates, more than half of the 30 public-use airports in the Bay Area are owned by municipal or county governments. Despite the lack of key

information and the dependence on policy and aid from other agencies, the final decisions still rest with local airport operators.

In its study of California air commerce airports, Stanford Research Institute noted that:

" . . . airport managements [as presently constituted in California] have little power to act with respect to the development of the more important airport functions. Airport management can attempt to make an airport accessible in the initial choice of location, but it has no control over the development of highways, freeways, rapid transit systems, or other facilities necessary to provide and maintain adequate accessibility. airport management can attempt to make airport operations compatible with surrounding land uses by initiating restrictions that reduce the utility of the airport for aircraft use or by purchasing extensive land. But unless it can secure zoning with respect to the uses of this land, as well as the heights of structures on it, local management has no protection against the future development of conflicting uses that may lead to restrictions on airport operations or even demands for the airport's removal Control of airspace and provision and control of most [aircraft navigation aids] rests with the FAA; and adequacy of air carrier service, or even its existence, is the responsibility of CAB"^{14/}

^{14/} Ibid., pp. V-14,15

Regional Planning for Airport Development

The nearest approximation to Bay Area regional airport planning at present is the FAA National Airport Plan: however, this plan is very short-range and does not consider implementation or local resources, nor does it propose any significant changes to the existing regional system. The FAA itself states that "It is the responsibility of each metropolitan or regional planning agency to begin to prepare airport system plans now in order to meet the needs of the future."^{15/}

1. Regional Planning Proposals

The need for a regional approach to air transportation facilities planning in the Bay Area has been noted by several agencies recently. The proposals by these agencies vary from a regional air transportation study to creation of a regional transportation authority. The agencies agree unanimously that the present airport planning and development methods are inadequate to cope with regional air transportation problems and that new ways of dealing with these problems should be explored.

In February 1961, the Golden Gate Authority Commission, a study commission created by State law, presented its final report to the California Legislature^{16/}. Among the conclusions of the Commission were the following:

^{15/} United States Federal Aviation Agency, National Airport Plan, FY 1966-1970, Washington D. C., 1965, p. 16.

^{16/} Golden Gate Authority Commission, Final Report on the Feasibility of a Regional Agency to Coordinate Transportation Facilities Serving the People of a Nine-County Metropolitan Region With Recommendations for a Golden Gate Transportation Commission for the San Francisco Bay Area. Sacramento, February 1961

"Some communities have had to shoulder heavy indebtedness and tax outlays to develop local transportation facilities which actually are regional in function -- and they now face even heavier commitments for necessary expansion and modernization . . .

. . . [There is a] need for a comprehensive Bay Area transportation program which can be carried out by an agency equipped with the required regional flexibility and financial capacity . . .

. . . This regional agency should have assigned to it all management, developing, and financing for the publicly-owned bridges, seaports and airports serving the nine-county Bay Area. It should encompass regional mass transit when such a system is established. . .

. . . The regional agency should be committed to carry out its functions within the framework of regional planning and policy determinations . . .

. . . It should be constituted so that it can easily be phased into any broader multi-purpose agency or governmental body which may develop later in the Bay Area. This means that it must be representative of, and accountable to, the communities of the metropolitan Bay Area . . .

. . . A regional agency with power to coordinate the Bay Area's bridges, airports, seaports, and related facilities will produce substantial public advantages which appear to be unattainable through any present alternatives. It will:

- (1) Allow effective regional action to meet the area's mounting transportation needs before they reach crisis proportions.
- (2) Concentrate responsibility for regional facilities in a regional body responsive to the total metropolitan complex it serves.
- (3) Relieve individual communities of the financial strain of providing regional facilities whose development should be a common regional concern.
- (4) Give the Bay Area a non-tax-consuming financial capacity for new transportation developments that will be considerably broader than any now existing.
- (5) Provide a vehicle through which the region can attack and correct San Francisco Bay's deficiencies in flood and salt water control, pollution, tideland reclamation, and shipping use."

Among its other powers, the proposed Golden Gate Transportation Commission would have been authorized to "negotiate for the acquisition of . . . publicly-owned airports subject to the terms and conditions set forth by proprietor municipality or jurisdiction."^{17/} It would not have had the power to condemn any publicly-held land.

"The basic factors militating for coordination of [publicly-owned airports and deep-water seaports] are population growth, high costs of capital improvements, the inroads

^{17/} Ibid. p. 10

made by competing areas, the waste represented by duplicate facilities and the lack of coordination service in the region."^{18/}

The bill creating the Authority was narrowly defeated by the Legislature in 1961, but there is evidence of renewed interest in the idea.

In a report on California air terminal needs prepared for the California State Office of Planning, the Stanford Research Institute concluded that "a basic need exists in California for regional planning to consider the collective needs of several metropolitan areas -- particularly the Los Angeles and San Francisco regional airport service areas."^{19/} The report points out that airports within a particular service area are becoming more and more interdependent, yet they vary considerably in resources and problems. In the opinion of SRI, there is much to be gained in system efficiency and economy from planning and developing facilities on a regional basis. It was recommended that special airport districts be established for each metropolitan area with authority to plan, develop and administer an air transportation system for the area. The district would be responsible for all air transportation facilities necessary to serve the region including non-commercial (general aviation) airports.

An informal prospectus by the staffs of the Bay Area Transportation Study Commission, Association of Bay Area Governments, and the

^{18/} Ibid., p. 17

^{19/} Stanford Research Institute, op. cit., p. II-10

Institute of Transportation and Traffic Engineering at the University of California, prepared in September 1965, proposed that a San Francisco Bay Area regional airport study be undertaken^{20/}.

The reasons given were:

1. The three regional development planning programs underway (ABAG, BATSC, BCDC) will include proposals which could seriously affect air transportation and, conversely, these proposals could be seriously affected by changes in the air transportation system.
2. Imminent technological changes in the aircraft industry have important implications for air transportation facilities needs.
3. The rapid growth of both air passenger and air cargo traffic will require major expansion programs at commercial airports soon.
4. General aviation is becoming increasingly important to Bay Area business and many new facilities are badly needed.
5. The problem of access to airports is becoming more serious and it is important to plan for airport accessibility along with airport development.
6. Good air transportation is important for the economic well-being of the region and will become more so.
7. Air transportation demand is area-wide and should be planned on a similar scale.

^{20/} Institute of Transportation and Traffic Engineering, University of California, Berkeley. Preliminary Prospectus: San Francisco Bay Area Regional Airport Study, September 1965. Draft for discussion.

This prospectus was prepared for discussion purposes only, and does not represent the official policy of agencies concerned. It does reflect the opinion of staff members studying various regional development problems. The proposal is being discussed with the FAA and local airport operators.

The Federal Aviation Agency is committed to a policy encouraging metropolitan air transportation planning. The San Francisco Area FAA office is currently engaged in discussions with Bay Area airport owners, stressing the need for a regional airport system study. Such a study would be the basis for considering proposals for long-range airport improvements with Federal funds. However, because of its responsibilities for airport adequacy and safety, the agency will continue to make funds available for what it considers to be necessary improvements.

The Goals and Organization (GO) Committee of the Association of Bay Area Governments is currently studying regional governmental needs in the Bay Area. As part of that study the Committee identified eight problems which it feels are "importantly interrelated, are widely recognized as regional in nature, and which merit immediate attention and priority."^{21/} Among the eight areas in all of which "there are problems of intergovernmental relationships," was Metropolitan Airport Planning. The Committee commented that

^{21/} Association of Bay Area Governments, Memorandum to Executive Committee from Goals and Organization Committee. Regional Government Needs and Priorities, May 19, 1966. p. 1

"Metropolitan Airport Planning is taking shape as an immediate metropolitan need. ABAG should act in timely fashion to anticipate this problem and determine how it can contribute to its solution, rather than further being faced with a proliferation of another regional special purpose agency."^{22/}

Local airport managements have also recognized the need for a regional approach. James K. Carr, General Manager of the San Francisco Public Utilities Commission in a letter to BCDC dated March 14, 1966, explaining future plans, points out that the long-range expansion program proposed for San Francisco International Airport "is beyond the resources of the City and County of San Francisco. It can only come about years hence as the outcome of the regional study embracing all airports in the Bay Area." He has sought the cooperation of the FAA and airport authorities in Oakland and San Jose. Although no firm proposal or commitment has been made by any party, Mr. Carr is hopeful that "some semblance of a regional study will be evolved in the foreseeable future."

New Alternatives from a Regional Study

At present, the only kind of planning that an airport operator in the Bay Area is able to do revolves around the questions of whether to expand the facility and how. A community can decide to build a heliport or general aviation airport. This approach is

^{22/} Ibid., p. 2

not likely to result in major changes to existing patterns, nor is it likely to result in an adequate airport system for the region.

A regional air transportation study in the Bay Area could examine several alternative systems which are not possible under present conditions. Some of these systems might prove to be more beneficial and economical to the Bay Area than the present one.

For example, one alternative to concentrating the bulk of commercial air service -- short as well as long haul flights -- at San Francisco International and continually expanding its facilities at increasing expense, is to divert an increased number of flights to satellite airports. This might lessen the need for major expansion at San Francisco International and ~~improve~~ improve service at Oakland, San Jose and Sonoma County airports. While the final decision would rest with the CAB, the Board would probably be more receptive to the findings of a region-wide study than to the presentations of individual airports.

On the other hand, the regional study might conclude that concentration at San Francisco International should continue but that general aviation should be diverted to other airports and that helicopter service throughout the metropolitan area should be improved.

Another possibility that would merit study is the establishment of a completely new inland regional airport for international and most long-range flights. Short- and heavily-travelled long-distance flight routes could be distributed among existing commercial airports. The need for more commercial airports of all

types should be examined as well as the needs of general aviation. Some of the sites which might be suitable for major airports are shown on Figure 6.

Such a study could survey the needs and resources of the whole Bay Area air travel "market" and allocate facilities, services and costs so as to benefit that market. In short, Bay Area air transportation would be studied as a system rather than as several individual, unrelated public and private investments. A truly regional system of air transportation facilities based on area-wide needs, resources and objectives cannot come from the aggregate decisions of several agencies serving different masters.

Whether a regional study would conclude that airport development in the Bay Area should be the task of some form of regional authority cannot be predicted. It appears that this approach might have definite advantages over the present system, however. Consideration should be given to a regional agency as one possible means of meeting future Bay Area airport needs.

SUMMARY

The growth of air traffic in the Bay Area reflects national and State trends. There is every reason to expect this growth to continue. Air transportation is very important to the regional economy, not only as source of employment but also because of higher level of economic activity which it makes possible. There have been no definitive studies of the effects which changes in the air transportation system here might have on the economy.

FIGURE 6
Possible Sites
for
Future
Air Commerce
Airports



There are 30 public-use airports in the Bay Area, half of which are operated by local governments. Air carrier activity is concentrated at four airports, with San Francisco International accounting for four-fifths of this. Capital expenditures to meet 1975 needs at the four air commerce airports may exceed \$100 million. Nearly all Bay Area airports serve areas outside the limits of their legal jurisdictions. None has the authority to ensure adequate access roads, facilities, airspace or navigation aids. Airport operators cannot ensure air carrier service nor can they accurately predict its volume or pattern. Many have inadequate technical and financial resources.

There is general agreement among persons who have studied air transportation here that this is a regional problem which can be resolved most efficiently and economically by a regional planning program. The present system of airport development here is not adequate to cope with future needs.

PART III. AIR TRANSPORTATION AND SAN FRANCISCO BAY

To the pilot and air traveler arriving at night, San Francisco Bay is the black void between the lights of the Peninsula and East Bay area. To the operator of a shoreline airport the Bay is the perfect clear zone, a path for airplanes to fly over without annoying anyone, and something to be filled in when land for expansion is needed. The Bay has been a major influence on the existing pattern of airports and airways here. At the same time, airports have had important effects on Bay and shoreline development.

The Bay Shoreline as a Location for Airports

Four military and three civilian airports are located on the shores of San Francisco Bay. In view of the site requirements for major airports, it is not surprising that these locations were selected. Airports require large flat sites with expansion possibilities, free from surrounding obstructions and away from areas where the airport could cause a nuisance. Locations must be convenient to ground transportation routes and population centers. Finally, land costs must be relatively low.

The Bay shoreline was the only location in the Bay Area that met all of these requirements during the 1920's and 1930's, when the existing major airports were being developed. The topography of the Bay Region leaves few large flat sites inside the Bay basin,

and most suitable sites away from the shore had been developed for other uses by that time. The water surface of the Bay insured that there would be an unobstructed flat area for clear and approach zones and the marshes and tidelands could be filled when expansion was necessary. Noise was a less serious problem in days past, and the areas where these airports were built were convenient to but some distance from built-up areas at the time. Railroads and highways generally followed the shoreline. Land costs were relatively low at the time: there was little competition for the marshes and tidelands close to the Bay front. All of the nine sites seriously considered for a "landing field" by the San Francisco Board of Supervisors were located on the edge of the Bay.

There are no sites within the Bay basin along or away from the shoreline which are suitable for new major airports. Unless one of the military air bases were to be made available for civilian use, the only way of significantly increasing commercial airport capacity in the inner Bay Area would be to expand San Francisco or Oakland International Airports by filling the Bay.

Other Possible Airport Locations

Conditions have changed since the existing airports were established. The population has increased and spread out from the central cities. The technology of air and surface transportation has made travel easier. The diminishing supply of land close to

the large cities has made outlying areas worthy of study. Because of these changes, the Bay shoreline may no longer be the best, or at least not the only, location for airports here.

1. Size and Distribution of Population

The population of the Bay Area in 1930 was about 1.6 million.^{1/} By 1965 it had increased to 4.3 million.^{2/} In 1930 very few people were flying, and most of these did so for pleasure. Today nearly 2/5 of the United States population has traveled in a commercial aircraft, and about 2/3 of all air passenger trips are for business purposes. The civil aviation market is many times bigger and more diverse today than it was in the 1930's.

In 1930, 2/5 of the nine-county Bay Area population lived within the city of San Francisco, compared to less than 1/5 today. The small market for air travel used to be concentrated at a few places. Today, population and economic activity -- and hence the air travel market -- have spread throughout the inner Bay Area and into several towns outside the Basin. The outlying parts of the Bay Area will grow even more rapidly in the future, as the supply of developable land close to the Bay decreases.

^{1/} United States Department of Commerce, Bureau of the Census, California Statistical Abstract, Washington, D.C., 1965

^{2/} California Taxpayers Association

No single airport site is convenient to all the people in the Bay Area; there are several sites that will be convenient to a sizable air market in the future. Not all of these sites are located on the shoreline of San Francisco Bay.

2. Transportation Technology

In a promotional brochure dated 1931, the San Francisco Board of Supervisors proudly claimed that Mills Field was "located twenty-two minutes by motor over a 125 foot wide highway [from the central part of San Francisco]^{3/}". It would be difficult to improve on that time today, so perhaps advances in technology have just kept things from getting worse. On the other hand, San Francisco International is just 20 minutes by helicopter from the Berkeley and Contra Costa heliports, and less than 10 minutes from Oakland. The Bay Area Rapid Transit System will bring Oakland Airport within 30 minutes' travel time of nearly all parts of the transit service area. These forms of transport hold great promise for the future.

Time, rather than distance, is the appropriate measure of accessibility. Helicopters, rapid transit, freeways, and other yet-to-be-established forms of intra-regional transportation can make almost any site in the Bay Area accessible in a reasonable amount

^{3/} Airport Committee of the San Francisco Board of Supervisors, San Francisco Airport: A Report, San Francisco, 1931, p. 68

of time. If a supporting transportation system were provided, a major airport in an outlying part of the Bay Area could be quite feasible in the future. It may be less expensive to build such an airport than to provide the same accessibility for the same number of people to one or two centrally-located airports.

3. Competition for Land

In the 1920's Bay Farm Island and the Mills Estate consisted of marshes and tidelands, partly reclaimed, with almost no urban development in the vicinity. There was no immediate demand for industry, housing, or recreation uses in those areas. The asking price for the Mills Field site was \$943 an acre.^{4/} A \$4 million bond issue would have been sufficient to buy and develop the entire 1,112-acre site, but this was rejected by San Francisco voters in 1930.

The cost of land in the vicinity of these airports is many times higher today, partly due to the presence of the airport but also as a result of the area's growth. Land is needed there for all types of activities, not all of which are related to or compatible with the airports. It may be that continued expansion of airports in these densely built-up areas at the expense of other land uses is not in the best interests of the region.

^{4/} Mel Scott, The San Francisco Bay Area: A Metropolis in Perspective, University of California Press, 1959, p. 227

4. Implications

In 25 years there may be as many as 3 million more Bay Area residents than there are today, and still more will come after. These people will use air transportation more often for more purposes. Also, they will need space for housing, employment and many other facilities.

These people will not all live and work close to San Francisco Bay. It may be that their air transportation needs can be met in other ways than by continued expansion of airports established nearly 40 years ago.

The Bay as an Airspace Resource

Bay Area residents probably suffer less from aircraft noise than residents of most metropolitan areas. This is largely due to the presence of the Bay. The principal regional flight paths are over this large area of open water. Except in the San Jose area, nearly all low-altitude aircraft operations take place over the Bay.

The takeoff and landing patterns at Oakland and San Francisco Airports, Alameda and Moffett Naval Air Stations and Hamilton Air Force Base are designed to make maximum use of the Bay airspace, in order to minimize aircraft noise over built-up areas. Nowhere else in the Bay region is there an unobstructed area which is as large and as likely to remain free of urban development as the Bay.

Airport Filling

Oakland and San Francisco International Airports, the Alameda Naval Air Station and Crissy Field in San Francisco are built almost entirely on land reclaimed from the Bay. The Oakland Airport is on 1,485 acres of reclaimed land; several thousand acres of unreclaimed land remain for expansion. The San Francisco Airport property consists of 3,400 acres already filled, with 1,800 acres remaining. The Alameda Naval Air Station property includes about 1,000 acres of filled land. Parts of Moffett and Hamilton Fields, as well as San Carlos and Palo Alto Airports, are built on what was formerly part of the Bay. Oakland and San Francisco have plans to do extensive filling to meet expected future traffic.

Although location may be a special consideration, airport fill itself is neither more nor less a problem than fill for other purposes. The materials and methods of filling for airports do not differ from those for other uses, nor is airport fill more likely to adversely affect the Bay than fill for other uses.

The BCDC report on Tidal Movement indicates that most fills, particularly large ones, interfere with tidal currents. Although no tests have been made, it can be supposed that the Alameda Naval Air Station fill which projects into the narrow gap at the head of the South Bay has interfered with the already poor water circulation in the South Bay. The Oakland Airport fill reportedly has caused siltation problems in the San Leandro Marina nearby. In

addition to effects on currents, all fills reduce the volume and surface area of water in the Bay and thereby reduce the amount of oxygen available for marine life and pollution abatement.

Except in the most densely built-up areas, there is not likely to be much need to fill land for general aviation airports. It is too expensive a process and other sites can usually be found. There has been a proposal to build a general aviation airport for business aircraft near India Basin in San Francisco, but this is on land already filled and part of which will be put to other uses. Because of topography and scarcity of vacant land there, shoreline sites seem to be the only answer to general aviation needs in San Francisco. As long ago as 1950, the California Division of Aeronautics recommended development of three new airports in San Francisco, all on waterfront sites.^{5/} A general aviation airport has been proposed on land to be filled at Point Isabel in Richmond.

Heliports and V-ports will be attracted to waterfront sites, but there are other ways to accommodate them besides filling. Heliports can be placed on rooftops and piers; V/STOL aircraft may also be able to use special piers.

^{5/} California Aeronautics Commission, California Airport Study. 1950-1970, April 1950, p. 32

Effects of Airports on Shoreline Development

Airports occupy several miles of Bay frontage in heavily built-up areas. Except in the case of seaplane bases, the airports do not use the water shoreline as such. Airports can and do occupy inland sites which have suitable location and physiographic characteristics. In addition to occupying large areas of land, airports are major determinants of land use in surrounding areas. The presence of an airport will prejudice development of an area toward certain uses and against others. Also, airports require certain supporting facilities which will further affect the land use pattern.

It has already been pointed out that airports tend to attract certain kinds of industrial and business uses, and to repel residential and most recreational uses. The industrial uses which they attract usually are not water-oriented; like the airport, they make little or no use of the shoreline as such. In this way, further waterfront area is taken for non-water-oriented uses.

With proper planning and control, it would be possible to allow certain water-oriented uses to develop along the shoreline near airports. As long as they present no flight path obstructions and can tolerate aircraft noise, small boat marinas, fishing and swimming beaches, golf courses and other open space uses could make good use of the waterfront. Auto race tracks and similar uses might also be suitable in the vicinity of airports. The San Mateo County General Plan, which envisions extensive filling for San

Francisco Airport expansion and for industry in the area south of the airport, proposes open space recreation uses for most of the shoreline area. The San Francisco Public Utilities Commission plans a small-boat marina for the waterfront near the proposed new cargo center at the airport. Two golf courses are located in the runway clear zones of Oakland Airport. Increasing pressures for public access to the Bay demand that full use be made of shoreline areas.

The freeways and other supporting services required by airports further affect the local development pattern. For example, the long-range expansion plan of San Francisco International Airport would almost certainly make a second Bayshore Freeway necessary. The implications of this freeway for the future of the Bay warrant careful consideration.

SUMMARY

Four major airports are situated on the shores of San Francisco Bay. All were established between 1926 and 1939, during which period the shoreline was one of the few Bay Area locations which met all the location and site requirements for airport development. But the growth and spread of population, improved transportation technology and increased competition for Bayfront sites have lessened the attractiveness of shoreline sites in favor of outlying areas.

San Francisco and Oakland Airports are built almost entirely on filled land, and the only way these airports can expand is by further filling. There is not likely to be much demand to fill Bay lands for general aviation airports, heliports and V-ports, except possibly in the most densely built-up areas. Neither airports nor the uses they attract use the waters or shoreline areas of the Bay, and they do repel some water-oriented activities. Multiple use of the shoreline near airports should be encouraged.

PART IV. AIR TRANSPORTATION AND PLANNING FOR THE BAY

Summary of Conclusions

1. All phases of civilian aviation traffic -- passenger, cargo, and general aviation -- are growing rapidly and this trend is expected to continue. Several new forms of aircraft will be introduced during the plan period, which will necessitate expansion and modification of existing airports and, probably, the building of new ones.

2. Good air transportation service -- air commerce and general aviation -- is essential to the economic well-being of the Bay Area. However, the degree to which particular decisions regarding airport development might affect the regional economy is not really known.

3. Air travel demand in a metropolitan region is area-wide; the service areas and impact areas of airports do not coincide with political boundaries. Because they share airspace and a common air travel market, Bay Area airports are highly interdependent at present and will become more so in the future.

4. Public agencies at all levels of government have an interest in air transportation, but the ultimate responsibility for and initiative in airport development now rests with local

governments, which operate and invest according to their own resources, interests and political limitations. Major changes to existing airport development patterns are unlikely under this system.

5. Heavy capital expenditures will be required during the next 20 years to develop and maintain an adequate air transportation system for the Bay Area. It is beyond the financial resources of most individual airports to meet what each feels is necessary to cope with expected demand. Many airports are unable to recover operating expenses and existing debt at present.

6. Airports require large areas of land having definite physiographic characteristics. Until recently, the Bay shoreline was the only place that satisfied all location and site requirements for major airports. Today the growth and spread of population and changes in technology are making other locations worthy of consideration.

7. Unless new air commerce and general aviation airports are built, there appears to be no long-range alternative to continued filling of the Bay for airport expansion at Oakland and San Francisco.

8. Airports are major determinants of local land use patterns and are heavy generators of surface traffic. Airports can be used to carry out regional planning objectives. Proposals to

expand existing airports or to build new ones should be carefully considered with reference to their effects -- positive and negative -- on local areas.

9. Airports and the uses they attract are not water-oriented. Continued expansion of shoreline airports will result in more and more non-water-oriented activity such as light industry, offices, and freeways occupying scarce Bay shoreline.

10. The need for a regional approach to the planning and development of a Bay Area air transportation system has been pointed out by several agencies. Such an approach could determine the long-range air transportation needs of the Bay Area; explore alternative ways of meeting these needs in the interest of the region as a whole; and develop an air transportation system consistent with the regional plans for the Bay Area.

Policy Considerations

1. In view of the growth of air transportation, its importance to the well-being of the region and the many problems associated with it, the Bay filling needs of airports must be evaluated in the broader context of accommodating the air transportation needs of the Bay Area.

While Bay fill is of immediate concern to the Commission, it is only one facet of the complex problem of planning and developing an air transportation system that is both economical and adequate

to serve the needs of the region. At the same time, local airport fill proposals must be balanced against other demands on the Bay and shoreline.

2. There is a need, and the time is appropriate, for an evaluation of the present system of airport planning and development, to determine whether it is the best way to meet the needs of the region in the future.

The present system of airport operation evolved from the early days of aviation nearly a half-century ago. Whether this system is the best one to carry on in the future cannot be answered in this report, but there is reason to believe that improvements could be made. In view of the recommendations of several agencies concerned with air transportation and the metropolitan area studies now under way, the time seems ripe for this evaluation. This should be done in the context of a long-range plan and development program for airport development.

3. There is a difference between short-range and long-range airport needs.

The proposed runway extensions at San Francisco and Oakland and the need for a San Francisco heliport are short-range problems that cannot wait for a major study of overall airport needs. The rate of traffic growth and the imminent introduction of certain new aircraft require that these issues be resolved soon. On the other

hand, proposals for new airports and other improvements to accommodate longer-range demands can and should wait for a broader look. Not only do these items have major implications for regional and local development, they will require large public capital investment. Therefore, decisions on them should be taken only after all alternatives have been considered.

4. The two objectives -- making optimum use of Bay and shoreline and securing the best and most economical airport system for the region -- are quite different and may be conflicting.

Whatever its merits for meeting Bay Area air transportation needs, the present system of airport planning and development is not oriented toward optimum use of San Francisco Bay. Unless the system is changed, the major airports will need to continually fill the Bay for expansion. Also, the airports will require supporting facilities and will attract other activities on to land which otherwise might be used by water-oriented activities. While changing the system may not obviate this, it is the only way that alternatives can be studied.

The Bay conservation objective could best be served by prohibiting further airport filling and by limiting the growth of air traffic at the major shoreline airports. However, in order to accomplish this objective in the face of growing air traffic demands, a new governmental context for Bay Area airport planning and development must be established. The first and essential step toward this is a regional airport system study.

5. The problems faced by airport operators will become more and more complex in the future. Continued patching of existing facilities, while expedient, will probably not be able to meet long-term Bay Area airport needs.

Some form of regional approach to airport planning and development will become imperative sooner or later. If steps are taken in this direction now, it may be possible to avoid having to fill extensive areas of the Bay. The longer the delay, the more remote this possibility becomes.

The following is a hypothetical sequence of events that could actually take place during the BCDC plan period. It is intended to illustrate how it might be possible to meet the Bay Area's long-term airport needs with a minimum amount of shoreline airport development.

A. First Stage (1966-1980)

(1) Either through State action or cooperative action of local communities, a regional study of air transportation needs is undertaken with the directive to prepare a long-range airport plan, exploring all reasonable alternatives to concentration of traffic at shoreline airports. The study concludes that certain inland locations are suitable and recommends that a regional agency assume responsibility for airport

development. Cooperation between FAA, CAB, and the regional agency to allocate air carrier service to serve regional needs in accordance with an overall plan.

(2) Detailed studies undertaken for design of a new inland regional airport and support facilities to handle international and some transcontinental traffic. Airport will be located at Travis Air Force Base,* and will be operational about 1980. Expansion of shoreline airports limited to that necessary to handle traffic until new airport is completed.

(3) Larger and faster helicopters are placed in metropolitan service. Service is extended to more Bay Area communities and also to Monterey, Santa Cruz, Stockton, and Sacramento.

(4) Short-haul and "stretched" jets in widespread use. Air cargo and passenger traffic increasing at fastest rate in history as fares are lowered.

(5) Several new general aviation airports are established to ease traffic pressures at commercial airports.

(6) Planning for V-ports begun. First facilities to be located at Oakland waterfront, downtown San Francisco, and San Jose Municipal Airport.

* Any sites mentioned are purely hypothetical and are used for illustrative purposes only

(7) Bay Area airports handling 35 million passengers and one million tons of air cargo by 1980.

B. Second Stage (1980-2000)

(1) Inland Regional Airport in operation, designed for supersonic and stretched jets carrying up to 1500 passengers each. Moffett Field is acquired for a new air commerce facility to replace San Jose Airport. Oakland, San Francisco, and Moffett handle large volumes of air commerce including some stretched jets. Sonoma County Airport at Santa Rosa is expanded to accommodate growing air commerce traffic there.

(2) V/STOL aircraft are in regular service between Sacramento, Bay Area, Los Angeles, and San Diego. V/STOL characteristics introduced on some long-distance aircraft.

(3) Helicopter service continually improving; fares lowered to the point where they are competitive with surface transport for intra-regional trips. Increasing use of helicopters by business firms.

(4) Very little general aviation traffic at air commerce airports. More business airports constructed, mostly by private enterprise, close to

industrial parks. Pleasure flying becomes increasingly popular, concentrated at San Jose, Hayward, Marin, Concord, and Napa airports.

(5) Planning begun to accommodate hypersonic, rocket-powered airliners expected soon after turn of the century.

(6) Cargo replaces passengers as largest segment of commercial air traffic.

C. Third Stage (2000-2020)

(1) Rocket-powered airliners operating from the regional airport to Europe and the Orient. Continuing increase in air traffic results in regional airport handling only international traffic, all of which is supersonic.

(2) V/STOL aircraft used exclusively on all trips under 1,000 miles, allowing the five conventional airports to handle longer trips.

(3) Helicopters supplant conventional aircraft as most popular general aviation vehicle.

(4) Virtually all passenger trips over 500 miles are made by air, as opposed to surface, transport.

6. Until a regional study is undertaken, the air transportation needs of the Bay Area must be satisfied under the present system.

Air traffic is growing rapidly; new and bigger aircraft requiring new and expanded facilities will be in service soon. Unless the operators of Bay Area airports decide that they will not accept these new aircraft -- which would be unlikely and probably unwise, without a study to determine the implications of this decision -- the need to fill the Bay will continue.



